Content, Assessment and Pedagogy (CAP): An Integrated Design Approach

Instructional Team:

Ruth Streveler, Karl Smith & Rocío Chavela

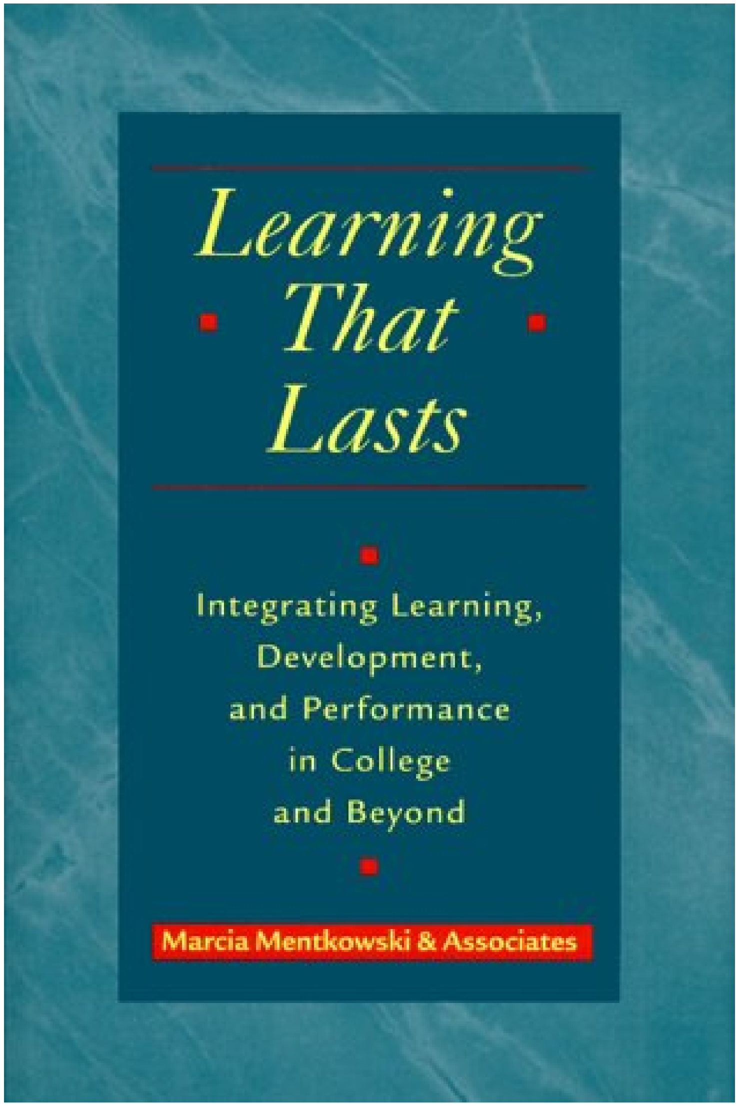
2009 Workshop for
The Committee for the Formation of Engineers Puebla-Tlaxcala

Session 3 – July 2, 2009

Session 3 Overview

- Welcome & Overview
- Reflections and Session 3
  - Participant “Think-Pair-Share” – Highlights, Insights, and Questions from Session 2
- Pedagogy
  - Planning Active and Cooperative Learning
- Aligning Content, Assessment, and Pedagogy
- Assignments & Next Steps

Resource: Learning that Lasts



Part One: Introduction 1

1 Themes and Purposes 3
2 Educators' Ways of Knowing About Learning 30

Part Two: Exploring Learning in College and Beyond 67

3 Student as Learner 69
4 Learner as Developing Person 105
5 Graduate as Performer and Contributor 143

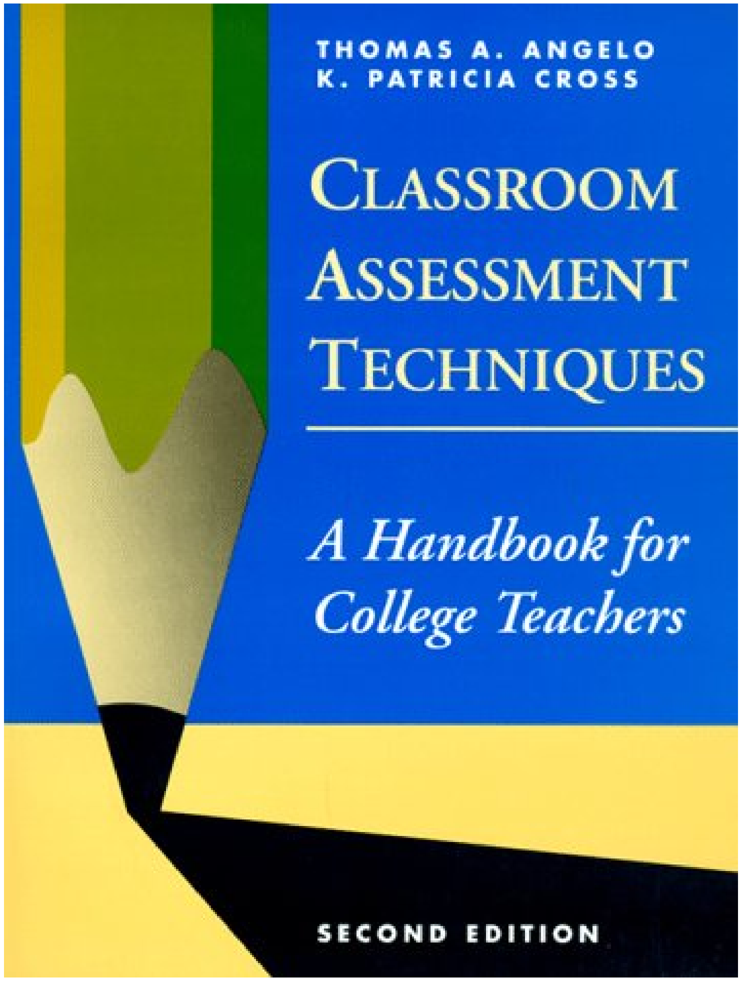
Part Three: Interpreting and Envisioning Learning That Lasts 177

6 Integrating Domains of Growth Through Transformative Learning 179
7 Creating the Learning-to-Teaching Connection 216

Part Four: Fostering Learning That Lasts 257

8 Integrating Theory, Research, and Practice 259
9 Thinking Through a Curriculum for Learning That Lasts 288
10 Rethinking Inquiry That Improves Teaching and Learning 330
11 Transforming the College Culture Toward Learning That Lasts 359
12 Looking Ahead 406

Resource: Classroom Assessment Techniques



- What classroom assessment entails and how it works.
- How to plan, implement, and analyze assessment projects.
- Twelve case studies that detail the real-life classroom experiences of teachers carrying out successful classroom assessment projects.
- Fifty classroom assessment techniques
- Step-by-step procedures for administering the techniques
- Practical advice on how to analyze your data

http://honolulu.hawaii.edu/intranet/committees/FacDevCom/guidebk/teachtip/assess-2.htm

http://www.celt.iastate.edu/teaching/cat.html

Exercise 1

- Three volunteers that would like to share one objective and get feedback from the instructional team

Exercise 2

- Find a new partner (someone that is not so familiar with your course).
- Share one learning objective and its assessment method(s)
- Provide feedback to your partner

Think-Pair-Share about Session 2

1. Reflect on session 2. Briefly describe your major learning, insights, and questions.

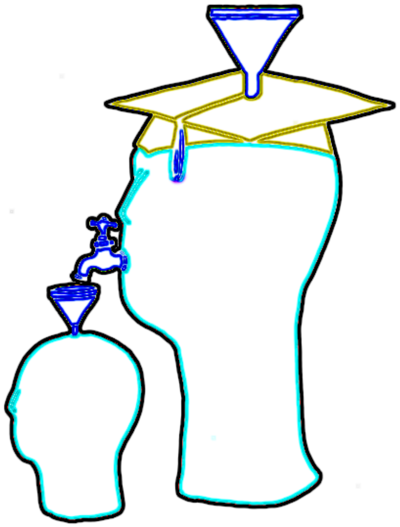
2. Explain what you think is meant by:
   a. Pedagogies of Engagement – Active and Cooperative Learning
   b. Alignment of Content, Assessment and Pedagogy

3. Talk with other members of your group.

Lila M. Smith

Pedago-pathologies

- **Amnesia**
- **Fantasia**
- **Inertia**



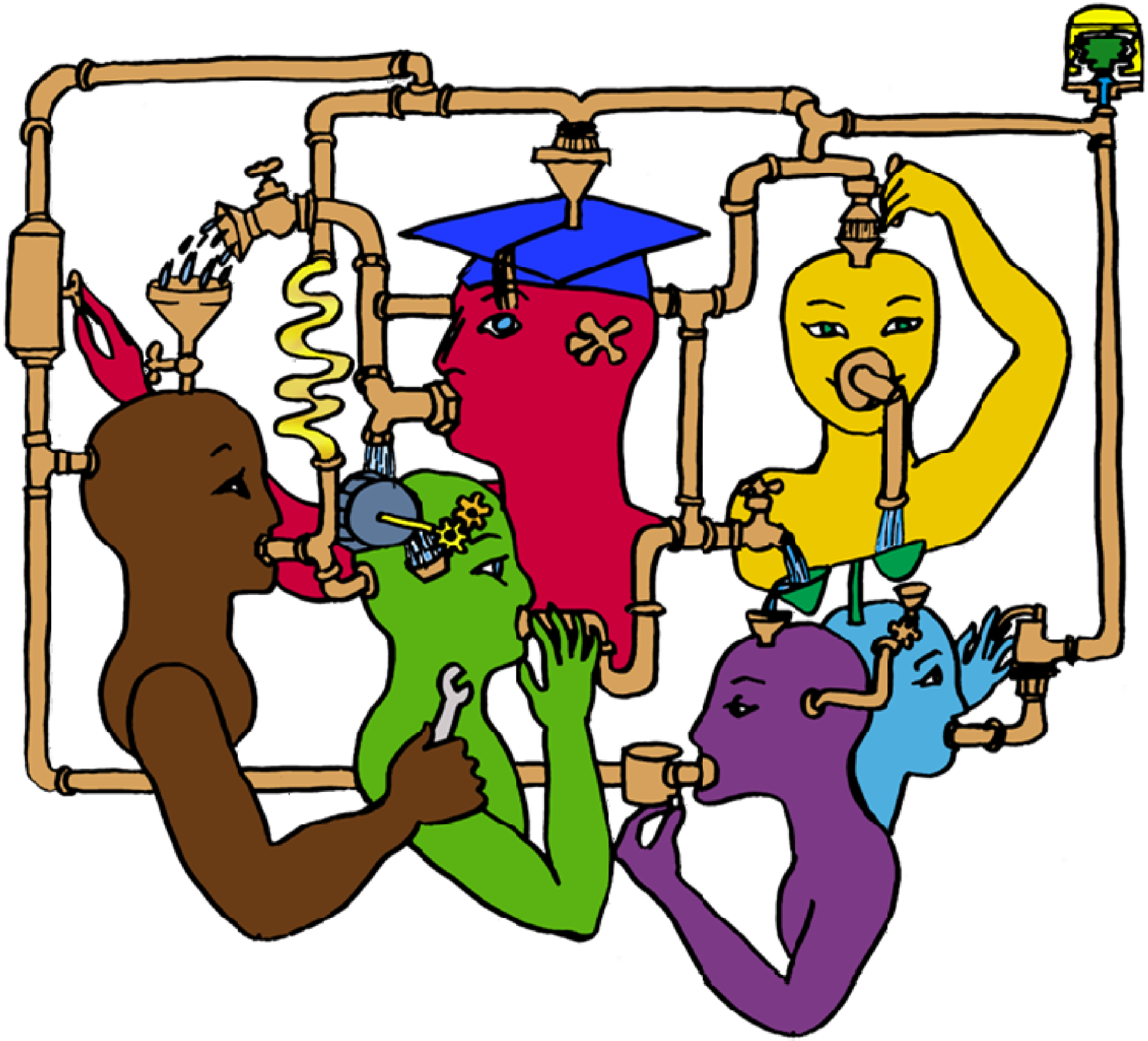
Lee Shulman – MSU Med School – PBL Approach (late 60s – early 70s); Stanford University, Past President of the Carnegie Foundation for the Advancement of College Teaching

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

What do we do about these pathologies? - Lee Shulman

- Activity
- Reflection
- Collaboration
- Passion

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



Pedagogies of Engagement

MIT & Harvard – Engaged Pedagogy

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

Jodi Hilton for The New York Times

The Massachusetts Institute of Technology has changed the way it offers some introductory classes. Prof. Gabriella Sciolla at a class on electricity and magnetism.

By SARA RIMER
Published: January 12, 2009

COMMENTS (00)
E-MAIL
PRINT
SINGLE PAGE

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,

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

EDUCATION

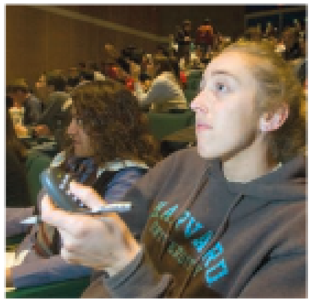
Farewell, Lecture?

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

Eric Mazur

Discussions of education are generally predicated on the assumption that we know what education is. I hope to convince you otherwise by recounting some of my own experiences. When I started teaching introductory physics to undergraduates at Harvard University, I never asked myself how I would educate my students. I did what my teachers had done—I lectured. I thought that was how one learns. Look around anywhere in the world and you'll find lecture halls filled with students and, at the front, an instructor. This approach to education has not changed since before the Renaissance and the birth of scientific inquiry. Early in my career I received the first hints that something was wrong with teaching in this manner, but I had ignored it. Sometimes it's hard to face reality.

When I started teaching, I prepared lecture notes and then taught from them. Because my lectures deviated from the textbook, I provided students with copies of these lecture notes. The infuriating result was that on my end-of-semester evaluations—which were quite good otherwise—a number of students complained that I was "lecturing straight from (his) lecture notes." What was I supposed to do? Develop a set of lecture notes different from the ones I handed out? I decided to ignore the students' complaints.



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."

A few years later, I discovered that the students were right. My lecturing was ineffective, despite the high evaluations. Early on in the physics curriculum—in week 2 of a typical introductory physics course—the Laws of Newton are presented. Every student in such a course can recite Newton's third law of motion, which states that the force of object A on object B in an interaction between two objects is equal in magnitude to the force of B on A—it sometimes is 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 concept not by doing traditional problems, 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 such questions, but much to my surprise, hardly 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 way 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 something was amiss.

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

Department of Physics, Harvard University, Cambridge, MA 02138, USA. E-mail: mazur@physics.harvard.edu

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

Calls for evidence-based teaching practices

http://web.mit.edu/edtech/casestudies/teal.html#video

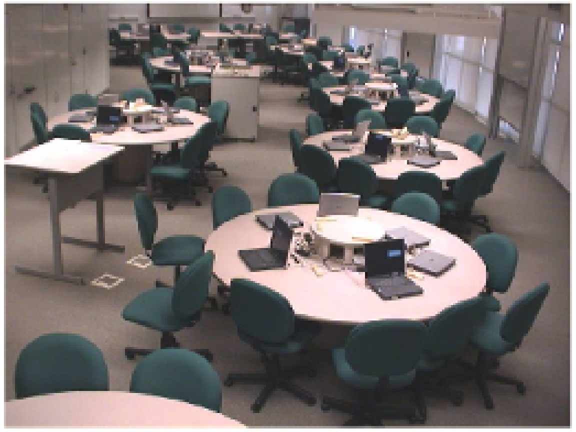
NC STATE UNIVERSITY

Quick Link: Click Here

Physics Education Research Group

- People
- Projects
- Publications
- Links
- Contact Us
- Home

Please click here if no menu appears



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 Pasco 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 100 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.

Classtime is spent primarily on "tangibles" and "ponderables". Essentially these are hands-on activities, simulations, or interesting questions and problems. There are also some hypothesis-driven labs where students have to write detailed reports. (This example is more sophisticated than most, but shows what the best students are capable of doing.) Students sit in three groups of three students at 6 or 7 foot diameter round tables. 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/adapting the SCALE-UP room design and pedagogy. Engineering schools are especially pleased with the course objectives, which fit in well with the requirements for ABET accreditation.

Materials developed for the course were incorporated into what became the leading introductory physics textbook, 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. 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 pretest/posttest protocol), and collected portfolios of student work. We have data comparing nearly 16,000 traditional and SCALE-UP students. Our findings can be summarized as the following:

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

Details

A chapter describing the approach and its underpinnings is available. A shorter description is posted on the PKAL website, or you can view an article describing the project from the proceedings of the Sigma Xi Forum on Reforming Undergraduate Education. The Raleigh *News & Observer* newspaper also has a description of the project. The very successful pilot project was described in the first issue of the Physics Education Research supplement to Am. J. of Physics. See our publication page for more information.

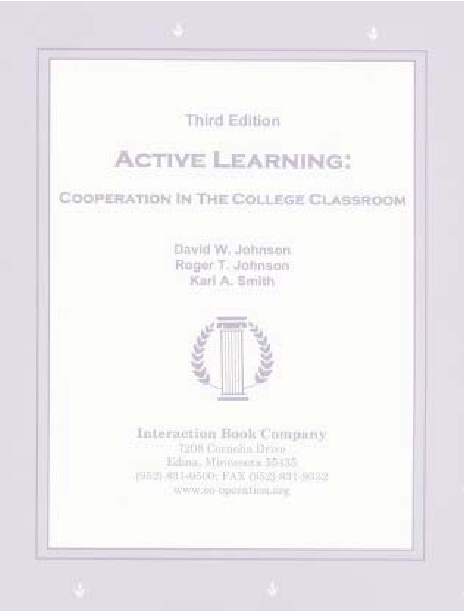
More than 50 colleges and universities across the US have adapted the SCALE-UP approach to their own institutions. In all cases, the basic idea remains the same: get the students working together to examine something interesting. That frees the instructor to roam about the room, asking questions and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

Cooperative Learning

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

Cooperative Learning (cont.)



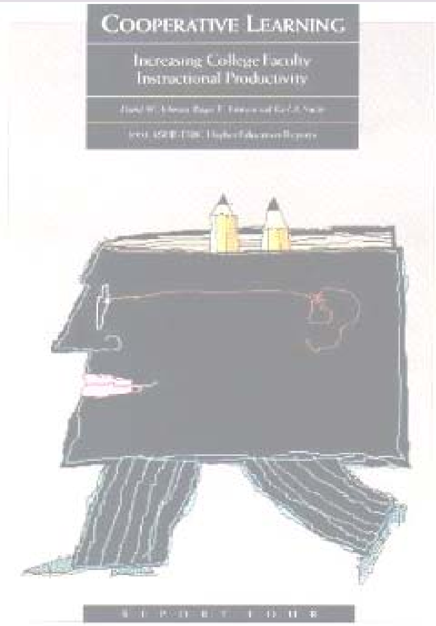
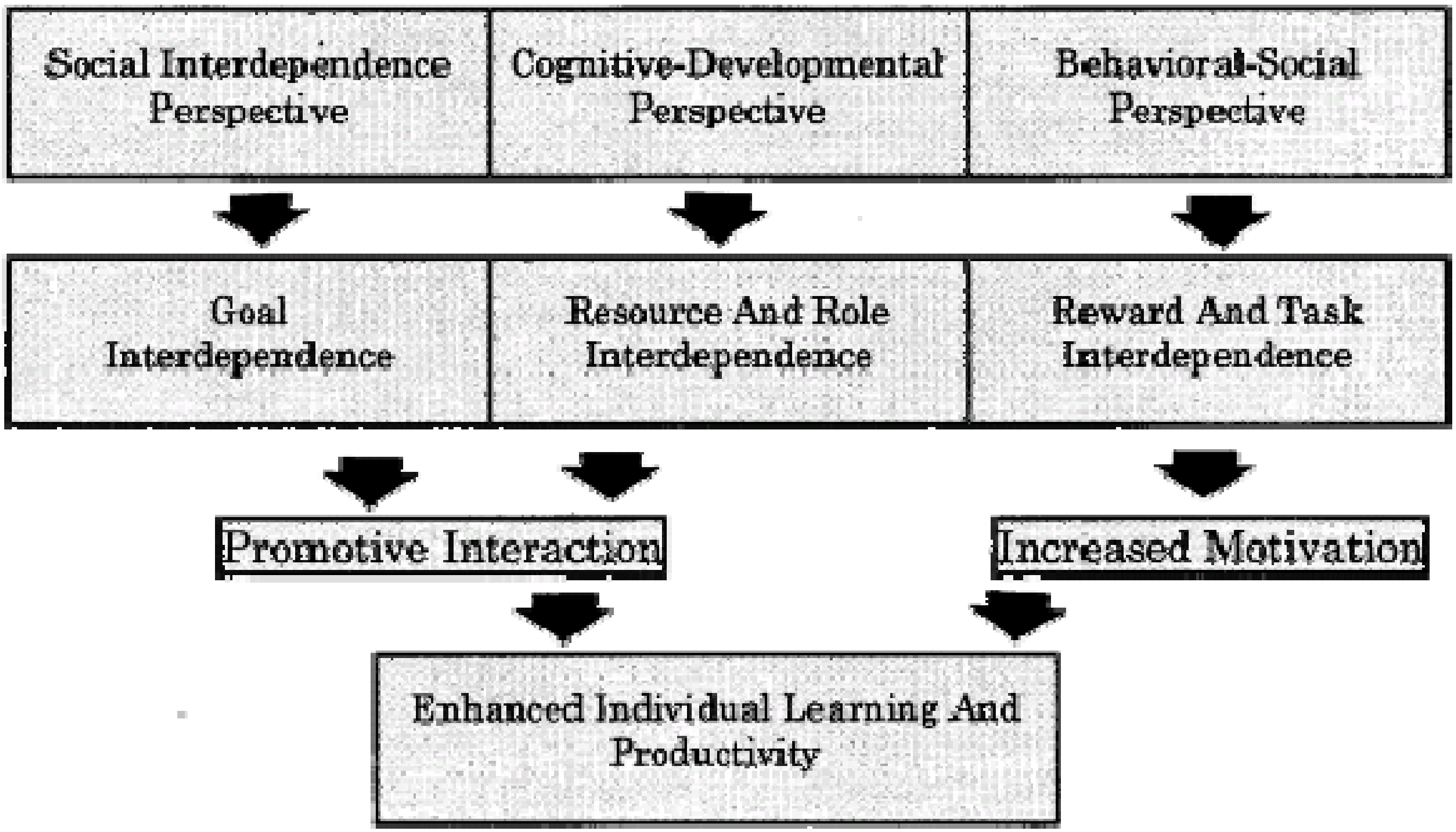


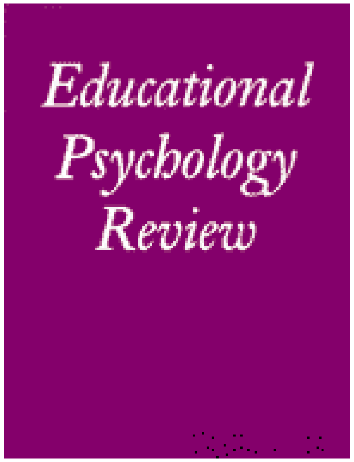
Figure A.1 A General Theoretical Framework



Cooperative Learning Research Support

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

January 2005



March 2007

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.

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

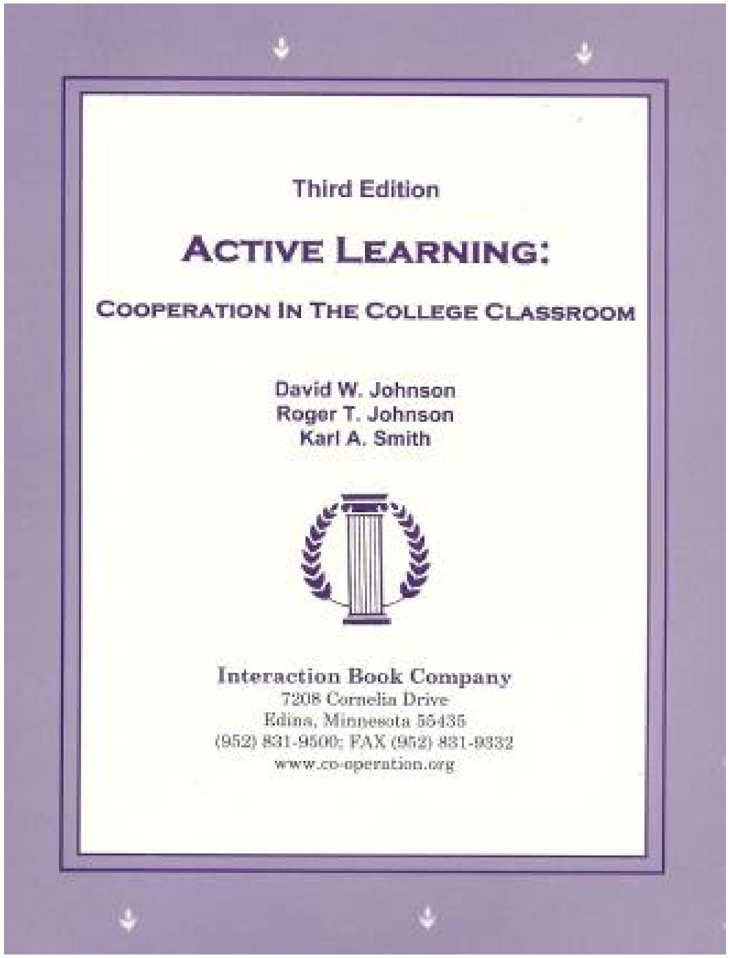
Faculty interest in higher levels of inquiry in engineering education

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

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

Active Learning: Cooperation in the College Classroom

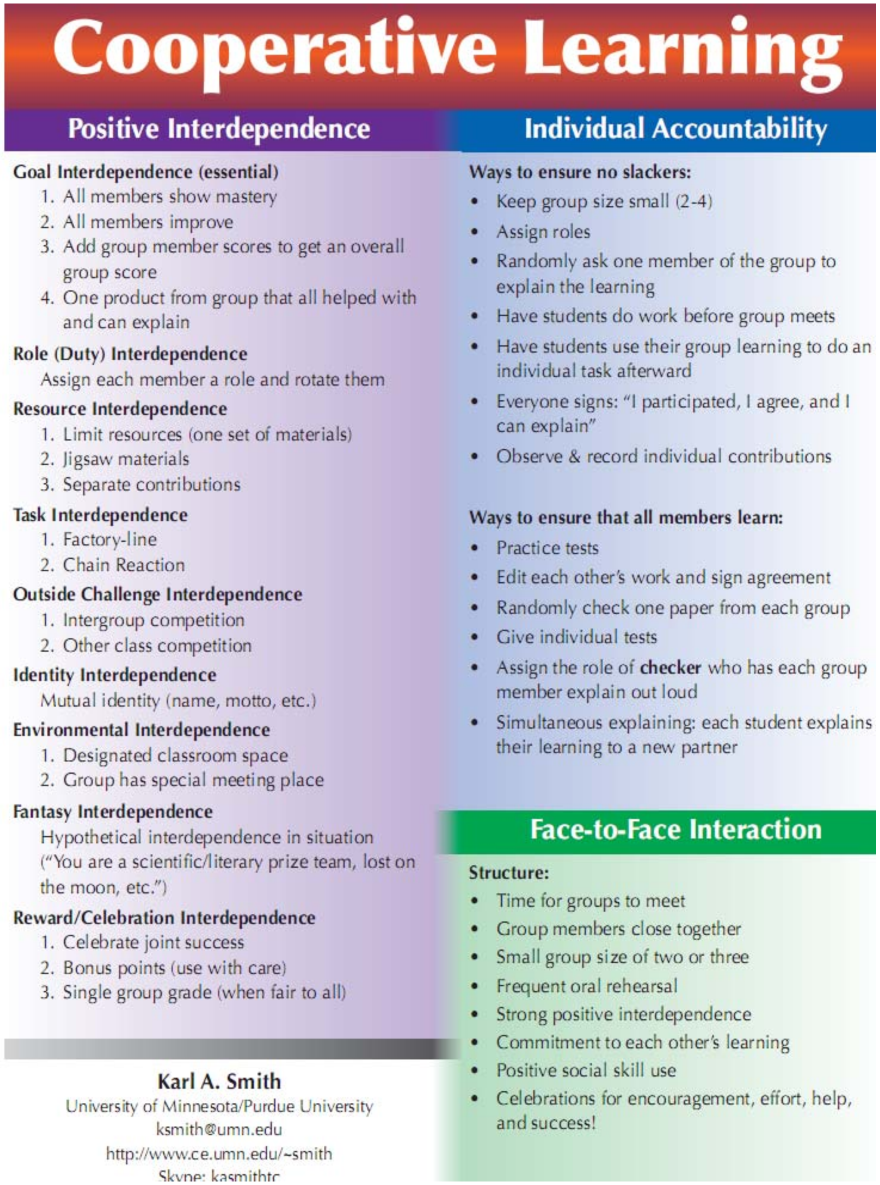
- **Informal** Cooperative Learning Groups
- **Formal** Cooperative Learning Groups
- Cooperative **Base** Groups



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

Cooperative Learning

- People working in teams to accomplish a common goal
  - *Positive interdependence* (all members must cooperate to complete the task)
  - *Individual and group accountability* (each member is accountable for the complete final outcome)



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)

Karl A. Smith
University of Minnesota/Purdue University
ksmith@umn.edu
http://www.ce.umn.edu/~smith
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!

Key Concepts

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

Individual & Group Accountability

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)

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

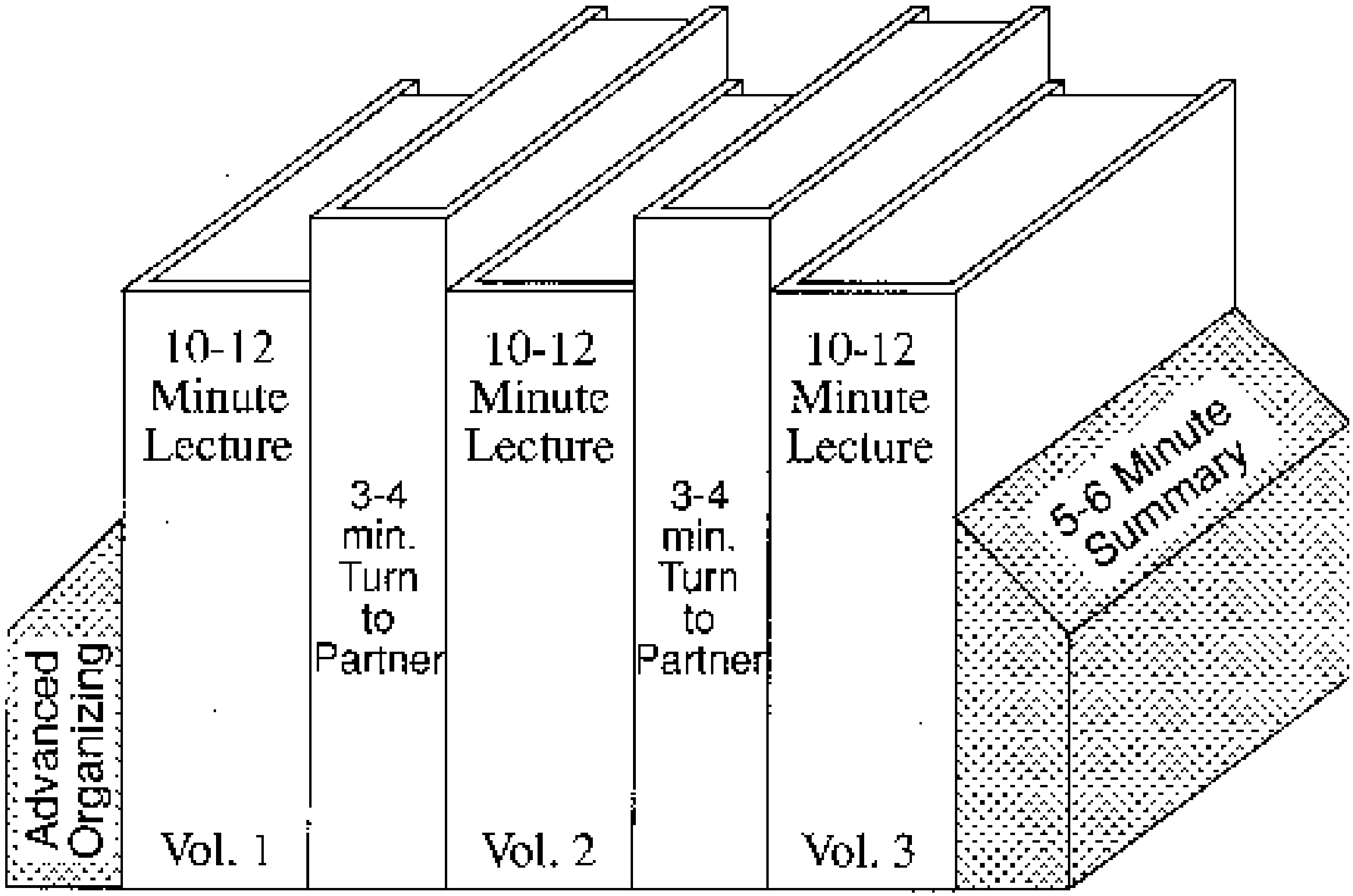
Structure:

- 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!

Karl A. Smith
University of Minnesota/Purdue University
ksmith@umn.edu
http://www.ce.umn.edu/~smith
Skype: kasmithtc

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

Book Ends on a Class Session



Advance Organizer

“The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly.”

David Ausubel - Educational psychology: A cognitive approach, 1968.

Book Ends on a Class Session

1. Advance Organizer
2. Formulate-Share-Listen-Create (Turn-to-your-neighbor) -- repeated every 10-12 minutes
3. Session Summary (Minute Paper)
   1. What was the most useful or meaningful thing you learned during this session?
   2. What question(s) remain uppermost in your mind as we end this session?
   3. What was the “muddiest” point in this session?

Advance Organizer

"The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly."

David Ausubel - Educational psychology: A cognitive approach, 1968.

Quick Thinks

- Reorder the steps
- Paraphrase the idea
- Correct the error
- Support a statement
- Select the response

Johnston, S. & Cooper,J. 1997. Quick thinks: Active- thinking in lecture classes and televised instruction. Cooperative learning and college teaching, 8(1), 2-7

Formulate-Share-Listen-Create

Informal Cooperative Learning Group
Introductory Pair Discussion of a

FOCUS QUESTION

1. Formulate your response to the question **individually**
2. Share your answer with a partner
3. Listen carefully to your partner's answer
4. Work together to create a new answer through discussion

Minute Paper

- What was the most useful or meaningful thing you learned during this session?
- What question(s) remain uppermost in your mind as we end this session?
- What was the “muddiest” point in this session?
- Give an example or application
- Explain in your own words . . .

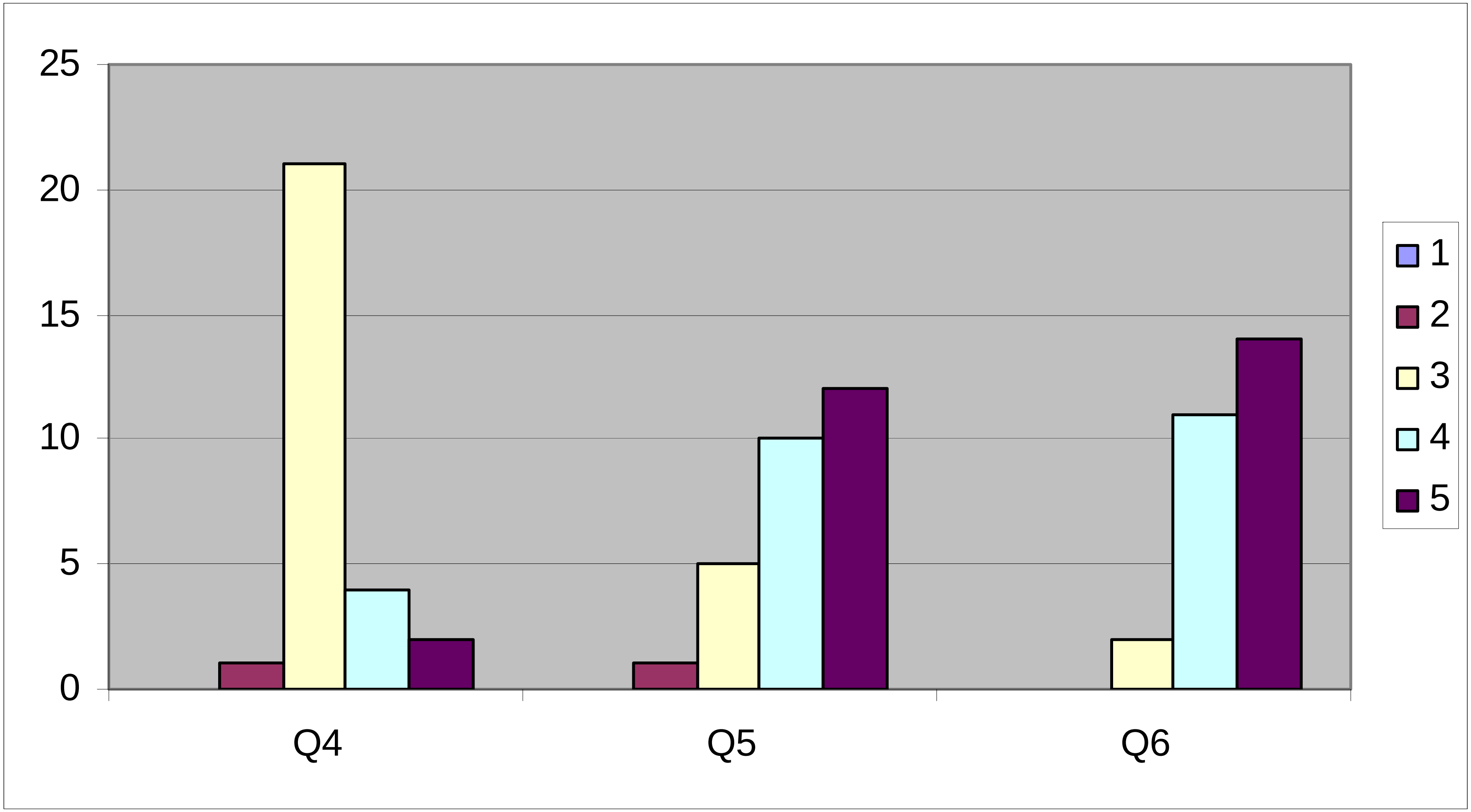
Angelo, T.A. & Cross, K.P. 1993. Classroom assessment techniques: A handbook for college teachers. San Francisco: Jossey Bass.

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

MOT 8221 – Spring 2009 – Session 1



Q4 – Pace: Too slow 1 . . . . 5 Too fast (3.3)
Q5 – Relevance: Little 1 . . . 5 Lots (4.2)
Q6 – Format: Ugh 1 . . . 5 Ah (4.4)

Informal CL (Book Ends on a Class Session) with Concept Tests

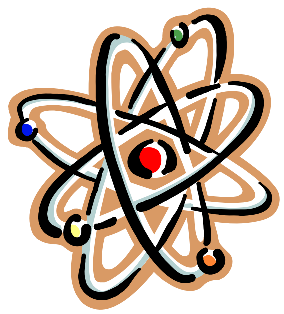
Physics

Peer Instruction

Eric Mazur - Harvard – http://galileo.harvard.edu

Peer Instruction – www.prenhall.com

Richard Hake – http://www.physics.indiana.edu/~hake/

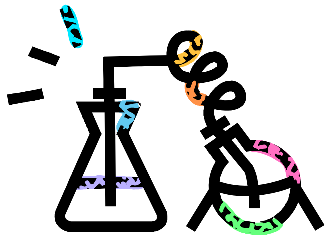


Chemistry

Chemistry ConcepTests - UW Madison
www.chem.wisc.edu/~concept

Video: Making Lectures Interactive with ConcepTests

ModularChem Consortium –
http://mc2.cchem.berkeley.edu/



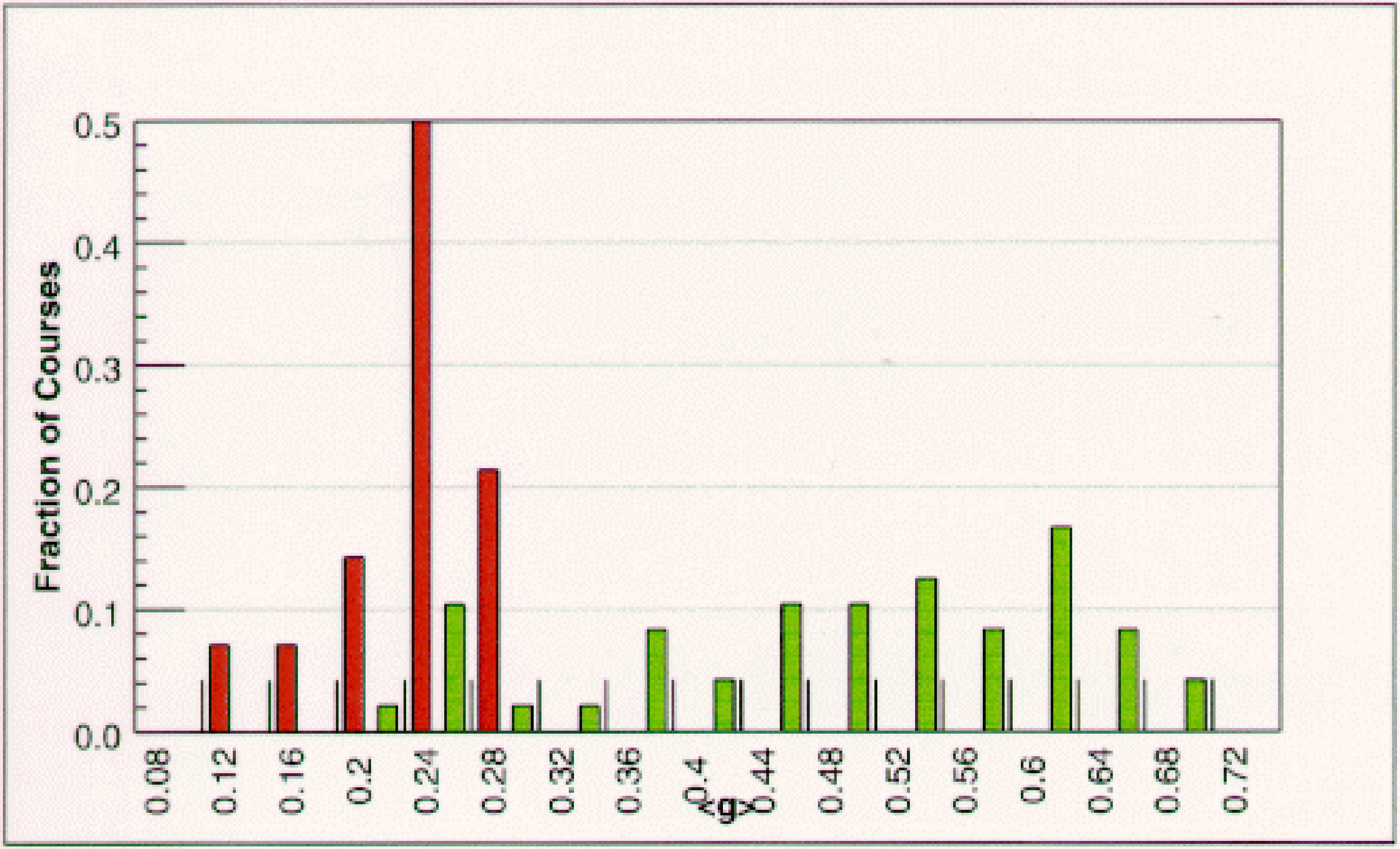
Informal CL (Book Ends on a Class Session) with Concept Tests

STEMTEC

Video: How Change Happens: Breaking the "Teach as You Were Taught" Cycle – Films for the Humanities & Sciences – www.films.com

Harvard

Thinking Together & From Questions to Concepts Interactive Teaching in Physics: Derek Bok Center – www.fas.harvard.edu/~bok_cen/



<g> = Concept Inventory Gain/Total

Fig. 2. Histogram of the average normalized gain <g>: dark (red) bars show the *fraction* of 14 traditional courses (N = 2084), and light (green) bars show the *fraction* of 48 interactive engagement courses (N = 4458), both within bins of width δ<g> = 0.04 centered on the <g> values shown.

III. CONCEPTUAL TEST RESULTS

A. Gain vs Pretest Graph - All Data

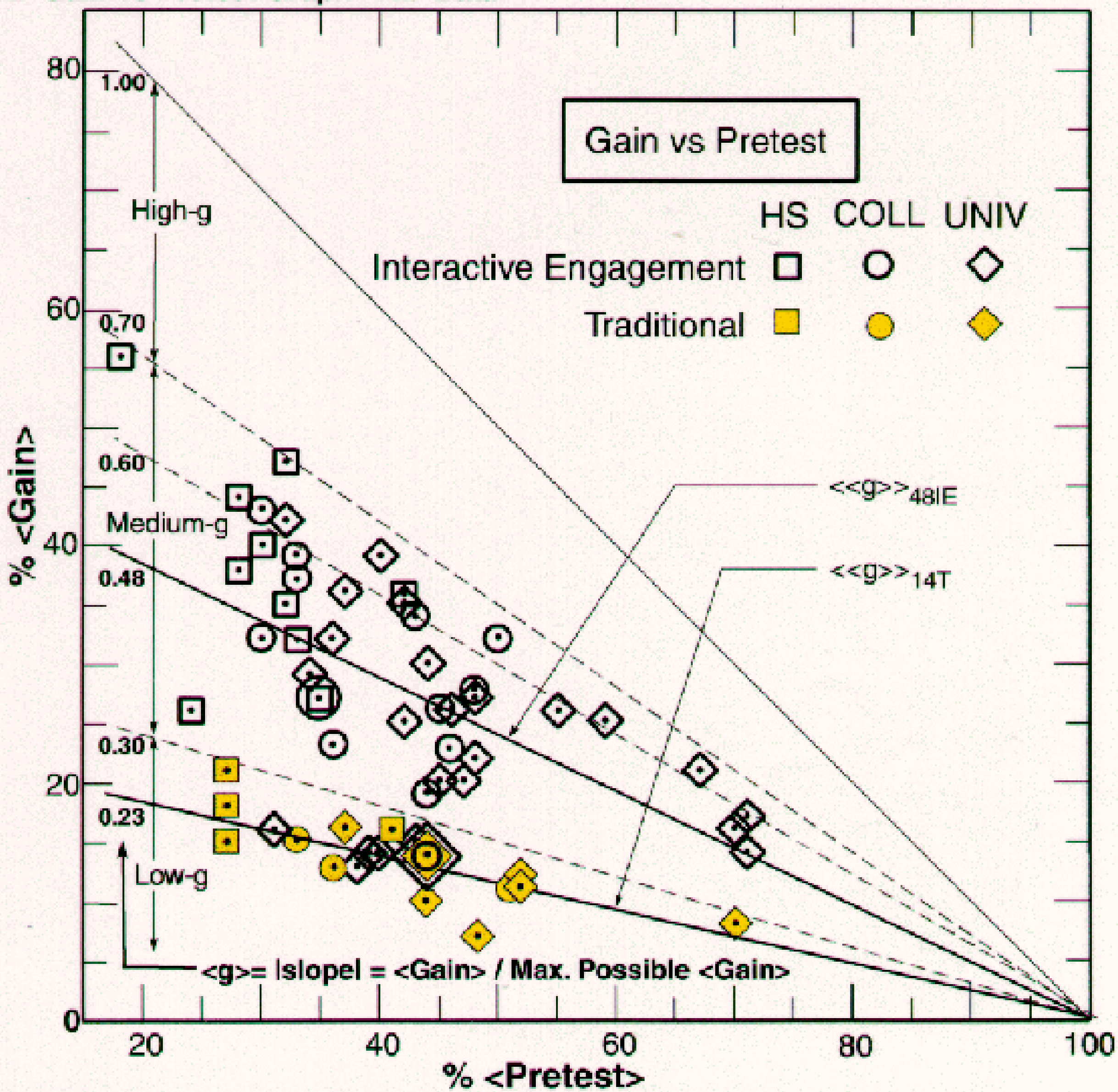
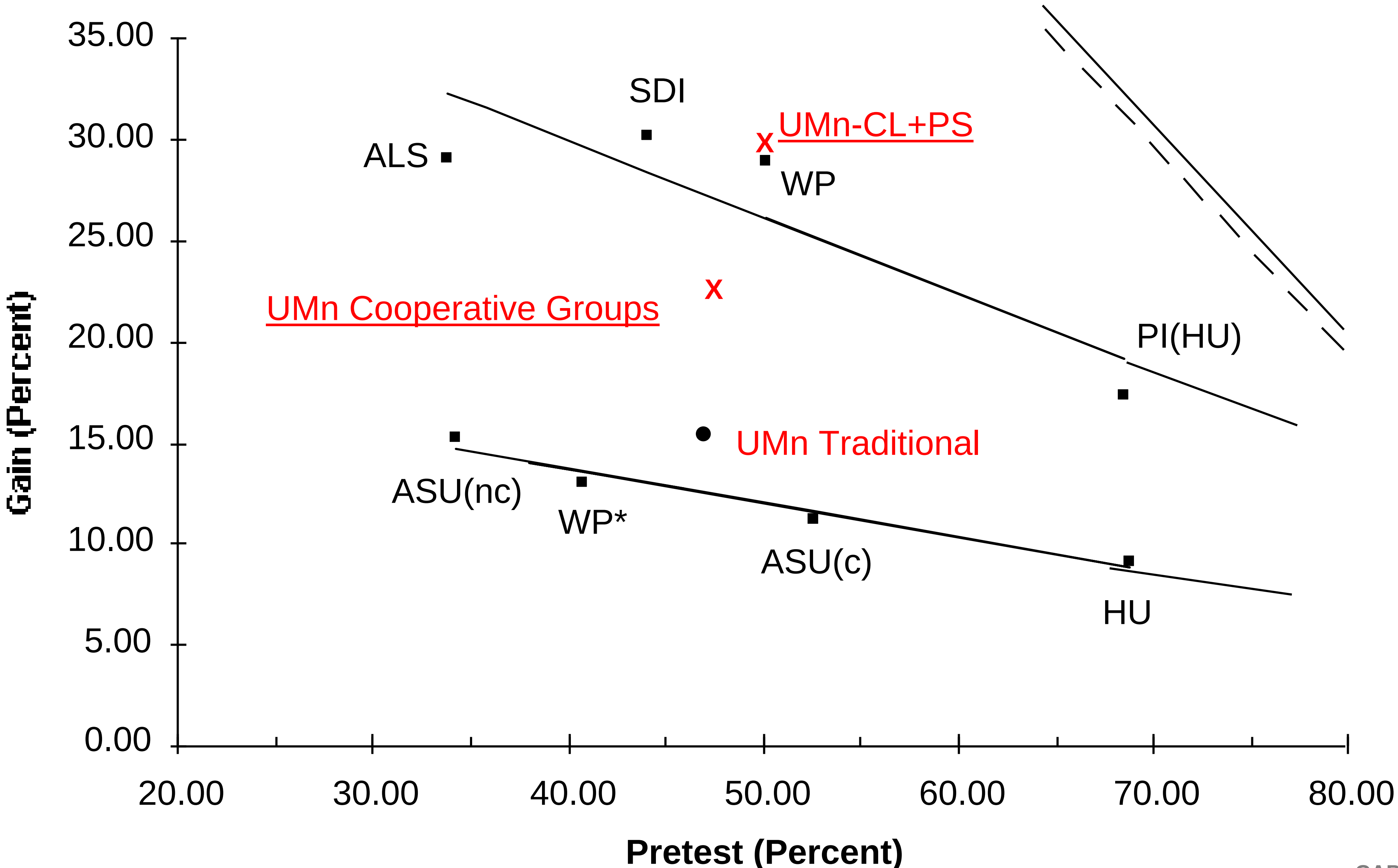


Fig. 1. %<Gain> vs %<Pretest> score on the conceptual Mechanics Diagnostic (MD) or Force Concept Inventory (FCI) tests for 62 courses enrolling a total N = 6542 students: 14 traditional (T) courses (N = 2084) which made little or no use of interactive engagement (IE) methods, and 48 IE courses (N = 4458) which made considerable use of IE methods. Slope lines for the average of the 14 T courses $\langle\langle g \rangle\rangle_{14T}$ and 48 IE courses $\langle\langle g \rangle\rangle_{48IE}$ are shown, as explained in the text.

The “Hake” Plot of FCI



Physics (Mechanics) Concepts: The Force Concept Inventory (FCI)

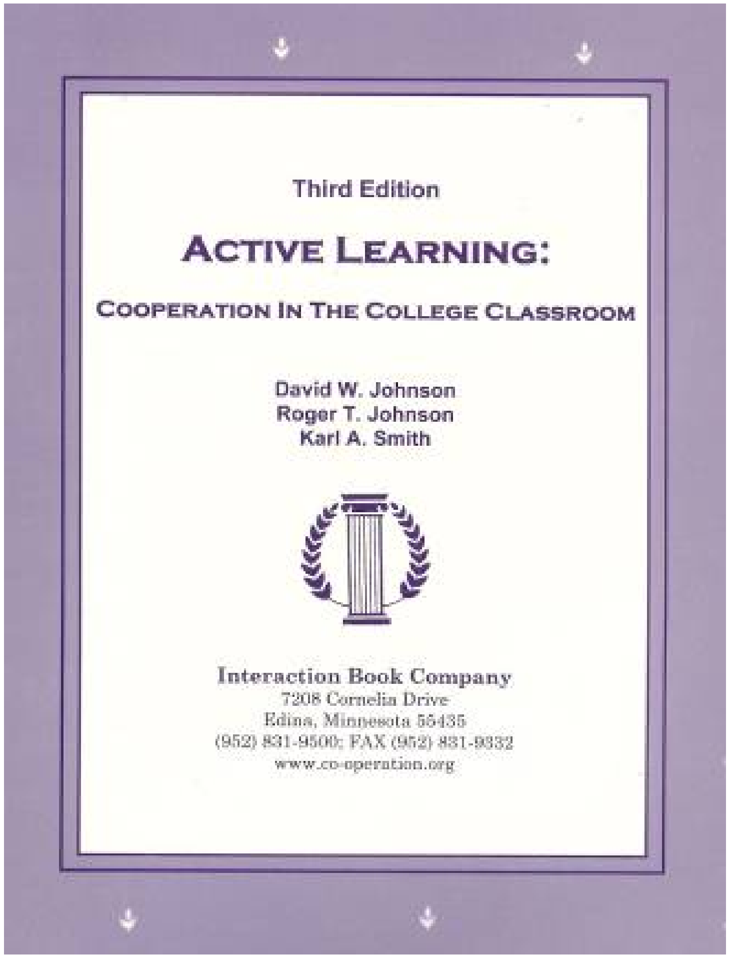
- A 30 item multiple choice test to probe student's understanding of basic concepts in mechanics.
- The choice of topics is based on careful thought about what the fundamental issues and concepts are in Newtonian dynamics.
- Uses common speech rather than cueing specific physics principles.
- The distractors (wrong answers) are based on students' common inferences.

Informal Cooperative Learning Groups

- Can be used at any time
- Can be short term and ad hoc
- May be used to break up a long lecture
- **Provides an opportunity for students to process material they have been listening to (Cognitive Rehearsal)**
- Are especially effective in large lectures
- Include "book ends" procedure
- Are not as effective as Formal Cooperative Learning or Cooperative Base Groups

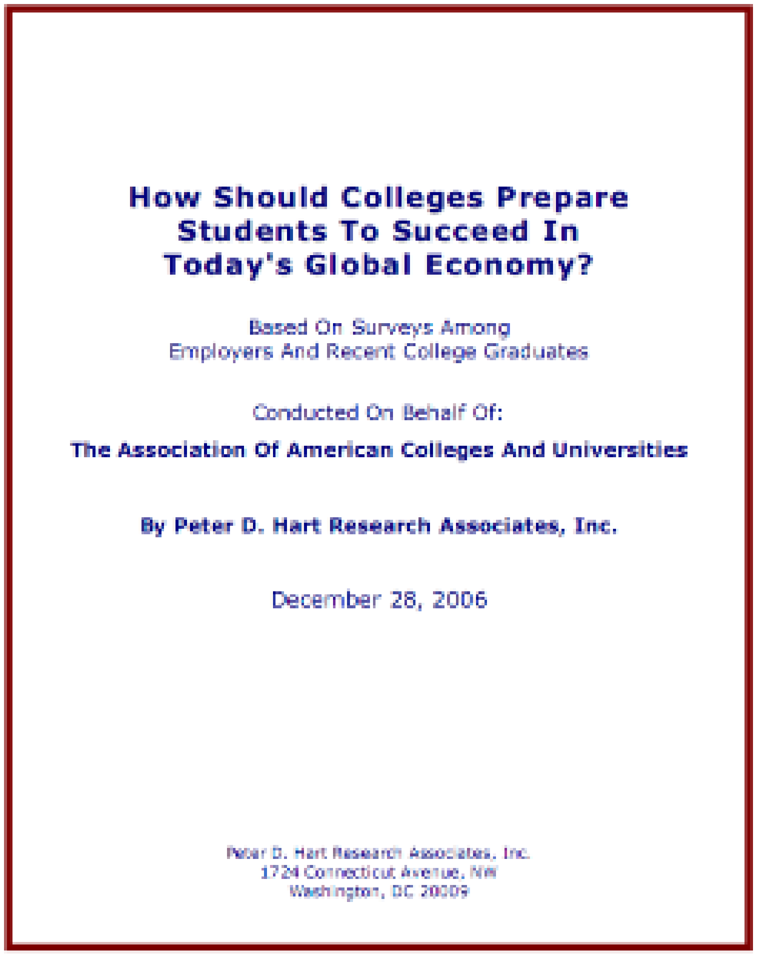
Active Learning: Cooperation in the College Classroom

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



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

Formal Cooperative Learning Task Groups



How Should Colleges Prepare Students To Succeed In Today's Global Economy?

Based On Surveys Among Employers And Recent College Graduates

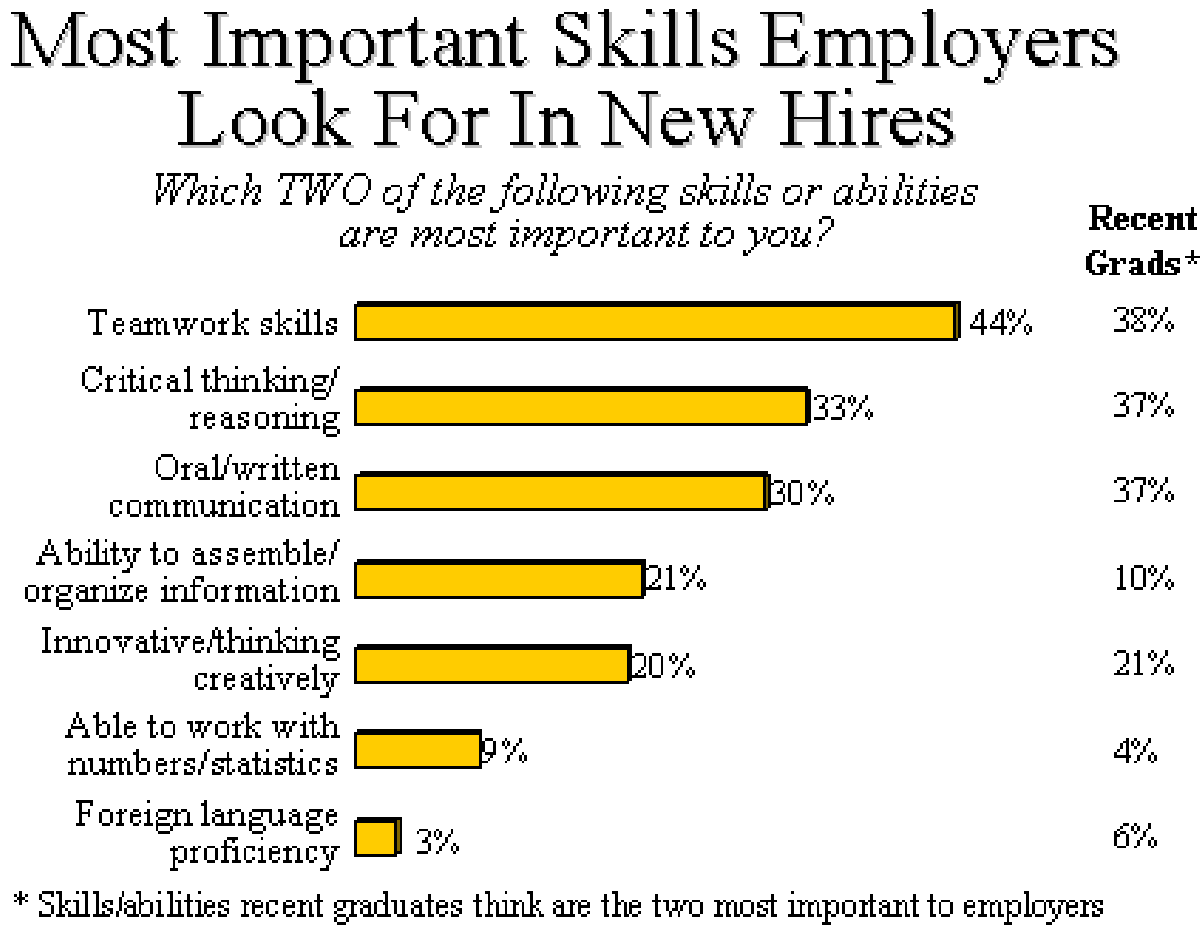
Conducted On Behalf Of:

The Association Of American Colleges And Universities

By Peter D. Hart Research Associates, Inc.

December 28, 2006

Peter D. Hart Research Associates, Inc.
1724 Connecticut Avenue, NW
Washington, DC 20009



http://www.aacu.org/advocacy/leap/documents/Re8097abcombined.pdf

Top Three Main Engineering Work Activities

Engineering Total

- Design – 36%
- Computer applications – 31%
- Management – 29%

Civil/Architectural

- Management – 45%
- Design – 39%
- Computer applications – 20%

Burton, L., Parker, L, & LeBold, W. 1998. U.S. engineering career trends. *ASEE Prism*, *7*(9), 18-21.

Teamwork Skills

- Communication
  - Listening and Persuading
- Decision Making
- Conflict Management
- Leadership
- Trust and Loyalty

Cooperative Teamwork Skills

Forming Skills
Initial Management Skills

- Move Into Groups Quietly
- Stay With the Group
- Use Quiet Voices
- Take Turns
- Use Names, Look at Speaker
- No "Put-Downs"

Functioning Skills
Group Management Skills

- Share Ideas and Opinions
- Ask for Facts and Reasoning
- Give Direction to the Group's Work (state assignment purpose, provide time limits, offer procedures)
- Encourage Everyone to Participate
- Ask for Help or Clarification
- Express Support and Acceptance
- Offer to Explain or Clarify
- Paraphrase Other's Contributions
- Energize the Group
- Describe Feelings When Appropriate

Formulating Skills
Formal Methods for Processing Materials

- Summarize Out Loud Completely
- Seek Accuracy by Correcting/Adding to Summaries
- Help the Group Find Clever Ways to Remember
- Check Understanding by Demanding Vocalization
- Ask Others to Plan for Telling/Teaching Out Loud

Fermenting Skills
Stimulate Cognitive Conflict and Reasoning

- Criticize Ideas Without Criticizing People
- Differentiate Ideas and Reasoning of Members
- Integrate Ideas into Single Positions
- Ask for Justification on Conclusions
- Extend Answers
- Probe by Asking In-depth Questions
- Generate Further Answers
- Test Reality by Checking the Group's Work

Teaching Cooperative Skills

1. Help students see the **need** to learn the skill.
2. Help them **know how** to do it (T-chart).
3. Encourage them to **practice** the skill daily.
4. Help them **reflect** on, process, & refine use.
5. Help them **persevere** until skill is automatic.

Monitoring, Observing, Intervening, and Processing

Monitor to promote academic & cooperative success

Observe for appropriate teamwork skills; praise their use and remind students to use them if necessary

Intervene if necessary to help groups solve academic or teamwork problems.

Process so students continuously analyze how well they learned and cooperated in order to continue successful strategies and improve when needed

Ways of Processing

Positive Feedback:

1. Have volunteer students tell the class something their partner(s) did which helped them learn today.
2. Have all students tell their partner(s) something the partner(s) did which helped them learn today.
3. Tell the class helpful behaviors you saw today.

Group Analysis:

1. Name 3 things your group did today which helped you learn and work well together.
2. Name 1 thing you could do even better next time.

Cooperative Skill Analysis:

1. Rate your use of the target cooperative skill: *Great! - Pretty Good - Needs work*
2. Decide how you will encourage each other to practice the target skill next time.

Start: *"Tell your partners you're glad they're here."*
End: *"Tell your partners you're glad they were here today. Thank them for helping."*

Interaction Book Company
5028 Halifax Ave S, Edina, MN 55424
(952)831-9500 Fax (952)831-9332
www.co-operation.org

REFERENCES
K.A. Smith, S.D. Sheppard, D.W. Johnson, R.T. Johnson. 2005. Pedagogies of engagement: Classroom-based practices. *Journal of Engineering Education*, 94 (1), 87-102.
D.W. Johnson, R.T. Johnson, & K.A. Smith. 2006. Active Learning: Cooperation in the College Classroom, 3rd Ed. Edina, MN: Interaction Book Company.

Teamwork Skills

- **Design team failure is usually due to failed team dynamics**

  (Leifer, Koseff & Lenshow, 1995).

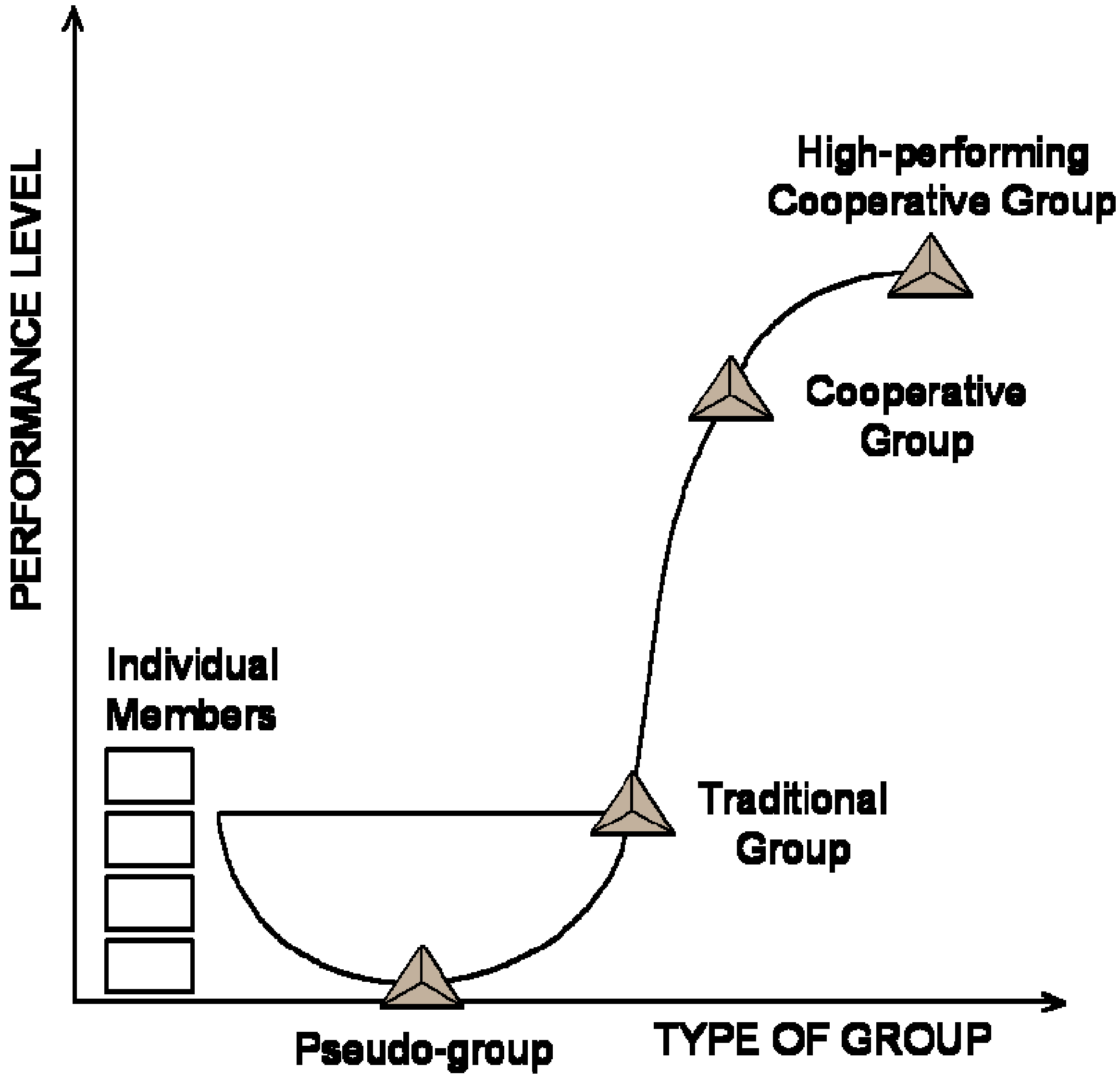
- **It’s the soft stuff that’s hard, the hard stuff is easy**

  (Doug Wilde, quoted in Leifer, 1997)

- **Professional Skills**

  (Shuman, L., Besterfield-Sacre, M., and McGourty, J., “The ABET Professional Skills-Can They Be Taught? Can They Be Assessed?” Journal of Engineering Education, Vo. 94, No. 1, 2005, pp. 41–55.)

Teamwork


PERFORMANCE LEVEL
High-performing
Cooperative Group
Cooperative
Group
Individual
Members
Traditional
Group
Pseudo-group
TYPE OF GROUP

Characteristics of Effective Teams

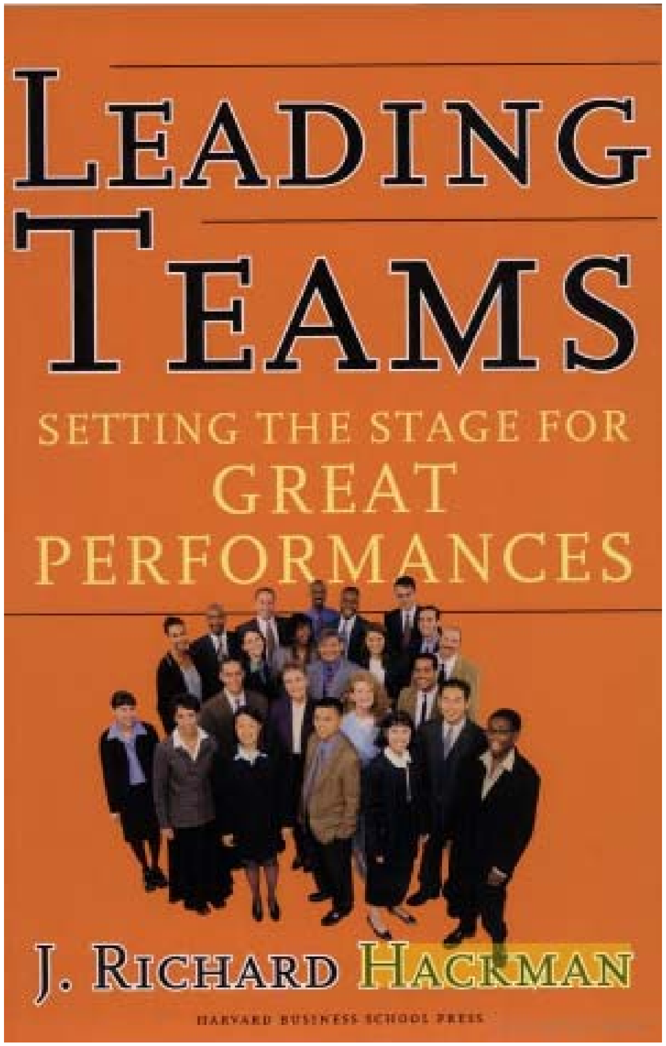
Characteristics of Effective Teams

A small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable

- SMALL NUMBER
- COMPLEMENTARY SKILLS
- COMMON PURPOSE & PERFORMANCE GOALS
- COMMON APPROACH
- MUTUAL ACCOUNTABILITY

--Katzenbach & Smith (1993) *The Wisdom of Teams*

Hackman – Leading Teams



- Real Team
- Compelling Direction
- Enabling Structure
- Supportive Organizational Context
- Available Expert Coaching

Team Diagnostic Survey (TDS)
https://research.wjh.harvard.edu/TDS/

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

Formal Cooperative Learning
Types of Tasks

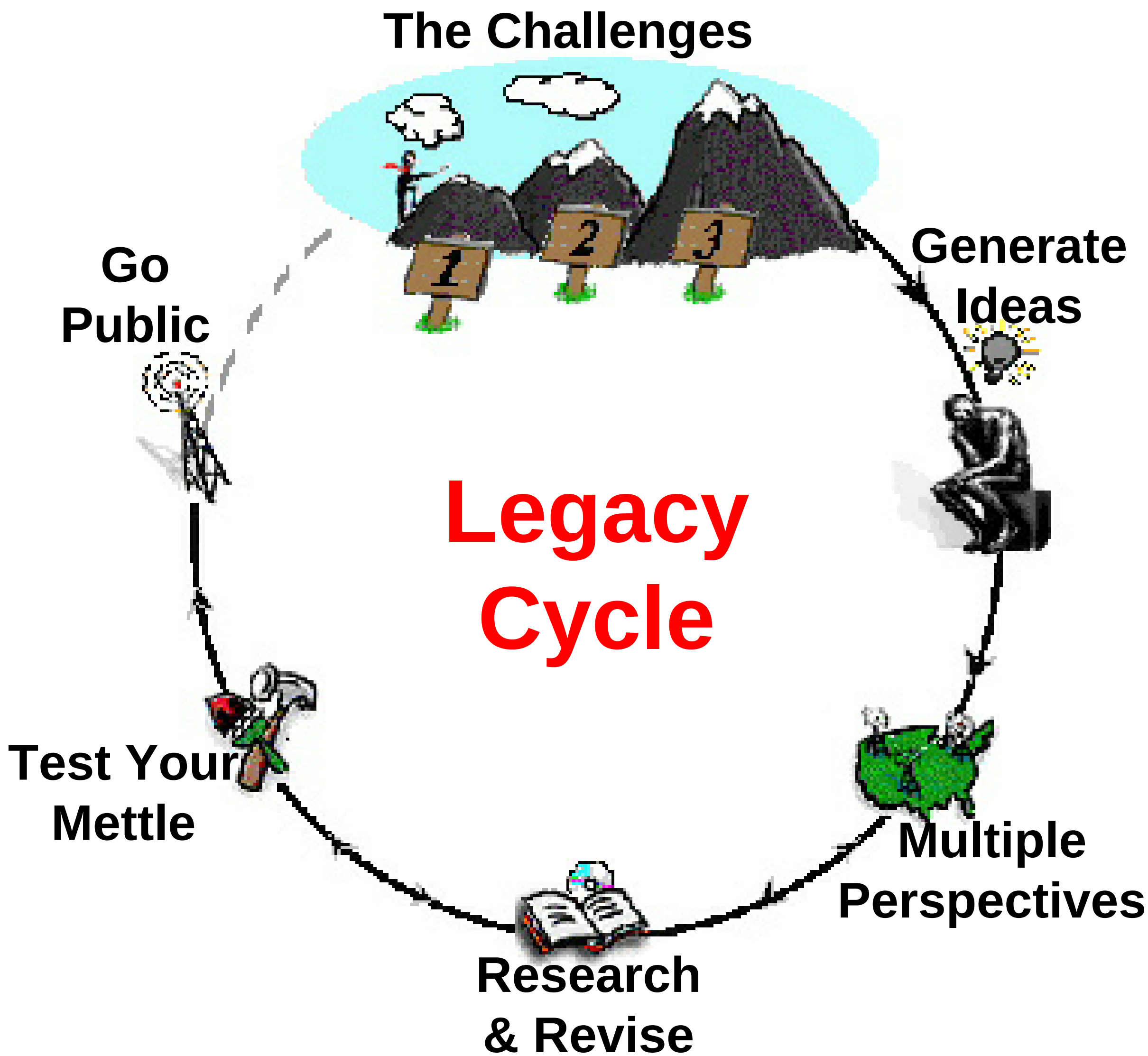
1. Jigsaw – Learning new conceptual/procedural material
2. Peer Composition or Editing
3. Reading Comprehension/Interpretation
4. **Problem Solving, Project, or Presentation**
5. Review/Correct Homework
6. Constructive Academic Controversy
7. Group Tests

Challenged-Based Learning

- Problem-based learning
- Case-based learning
- Project-based learning
- Learning by design
- Inquiry learning
- Anchored instruction

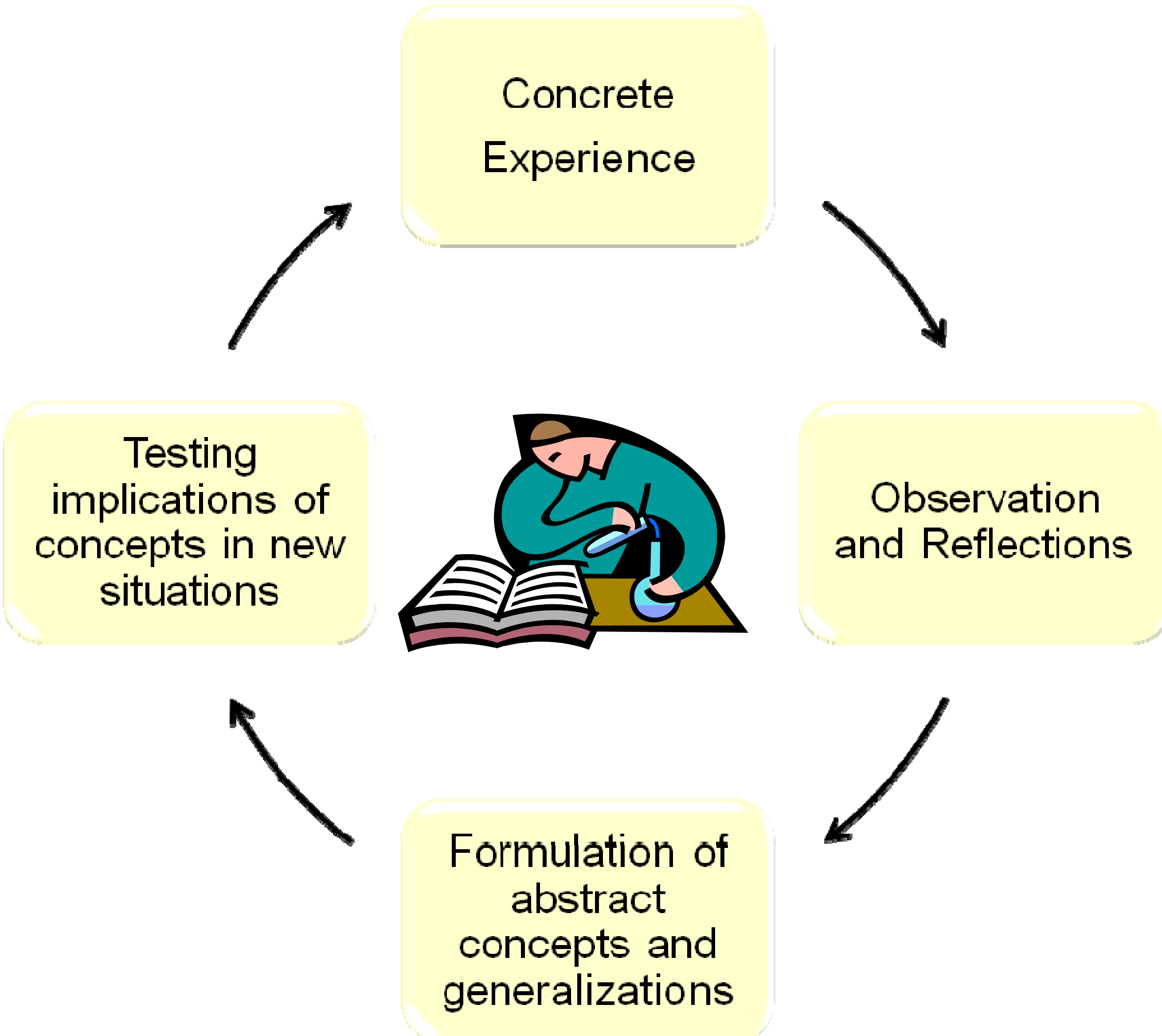
John Bransford, Nancy Vye and Helen Bateman. Creating High-Quality Learning Environments: Guidelines from Research on How People Learn

Challenge-Based Instruction with the Legacy Cycle



https://repo.vanth.org/portal/public-content/star-legacy-cycle/star-legacy-cycle

Kolb’s Experiential Learning Cycle

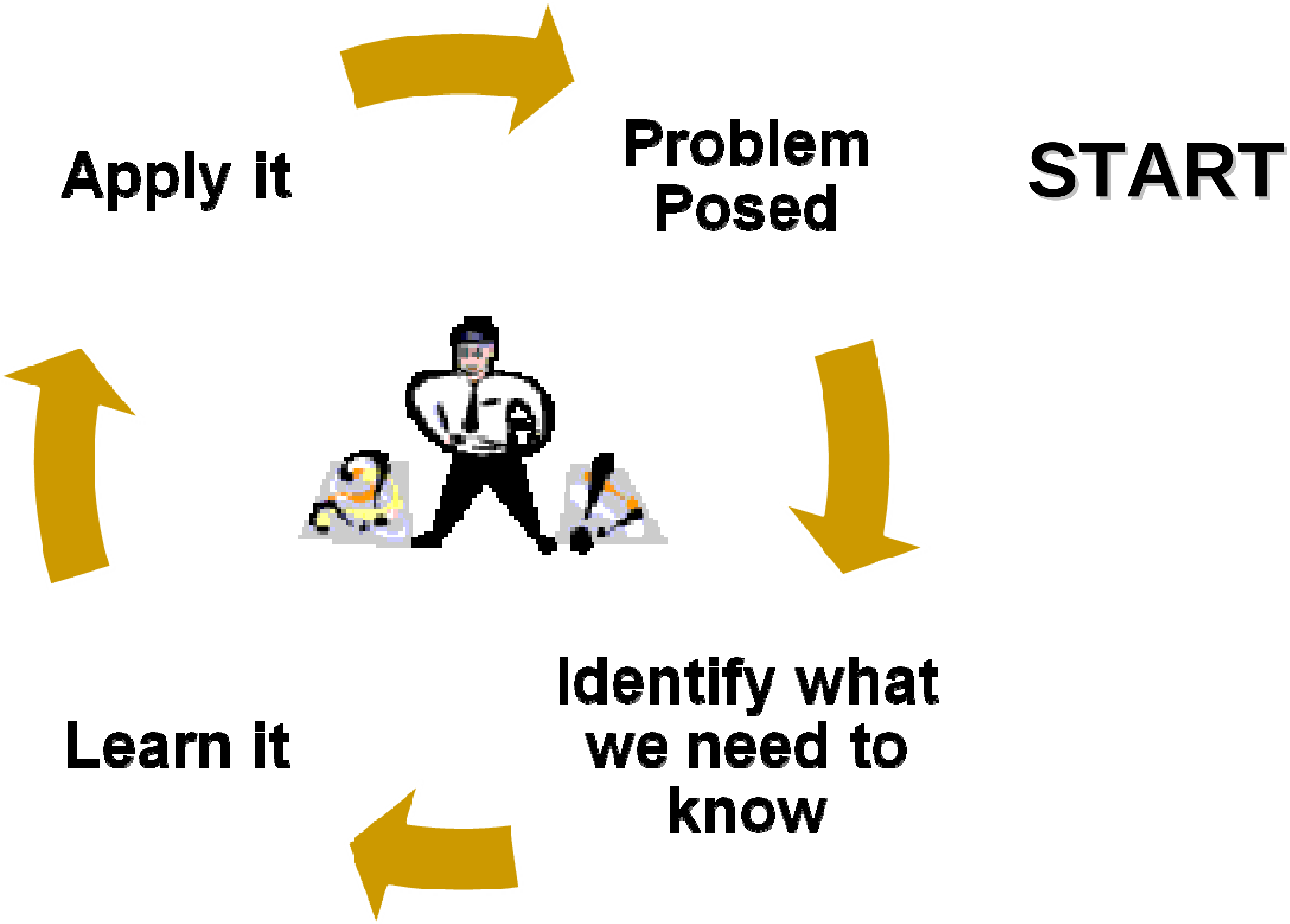


5 E Learning Cycle Model

- Engage
- Explore
- Explain
- Elaborate
- Evaluate

http://faculty.mwsu.edu/west/maryann.coe/coe/inquire/inquiry.htm

Problem-Based Learning



Problem Based Cooperative Learning Format

- **TASK**: Solve the problem(s) or Complete the project.
- **INDIVIDUAL:** Estimate answer. Note strategy.
- **COOPERATIVE**: One set of answers from the group, strive for agreement, make sure everyone is able to explain the strategies used to solve each problem.
- **EXPECTED CRITERIA FOR SUCCESS**: Everyone must be able to explain the strategies used to solve each problem.
- **EVALUATION:** Best answer within available resources or constraints

Problem Based Cooperative Learning Format

- **INDIVIDUAL ACCOUNTABILITY:** One member from your group may be randomly chosen to explain (a) the answer and (b) how to solve each problem.

- **EXPECTED BEHAVIORS**: Active participating, checking, encouraging, and elaborating by all members.

- **INTERGROUP COOPERATION**: Whenever it is helpful, check procedures, answers, and strategies with another group.

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

UD PBL

Please direct comments, suggestions, or requests to ud-pbl@udel.edu.
"http://www.udel.edu/pbl/"
Last updated March 11, 2004.

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

Cooperative Base Groups

- Are Heterogeneous
- Are Long Term (at least one quarter or semester)
- Are Small (3-5 members)
- Are for support
- May meet at the beginning of each session or may meet between sessions
- Review for quizzes, tests, etc. together
- Share resources, references, etc. for individual projects
- Provide a means for covering for absentees

Exercise

- What kind of learning environments will produce the outcomes you are assessing?
- Complete your worksheet using the questions on the next page.

Backward Design

Plan Learning Experiences & Instruction

- What enabling knowledge (facts, concepts, and principles) and skills (procedures) will students need to perform effectively and achieve desired results?
- What activities will equip students with the needed knowledge and skills?
- What will need to be taught and coached, and how should it be taught, in light of performance goals?
- What materials and resources are best suited to accomplish these goals?
- Is the overall design coherent and effective?

Worksheet for Designing a Course/Class Session/Learning Module

Learning Goals for Course/Session/Learning Module:	**Ways of Assessing This Kind of Learning:**	**Actual Teaching-Learning Activities:**	**Helpful Resources:** (e.g., people, things)
1.			
2.			
3.			
4.			
5.			
6.			

Next Steps

- What questions do you still have about the next steps?
- What information do you need to explain your plan into a year-long project?