Linking Insights from How People Learn to the Process of Planning Undergraduate Learning Spaces

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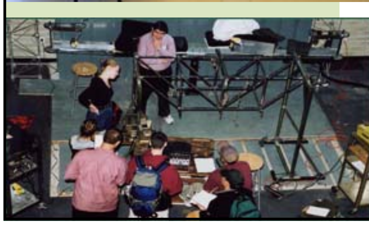

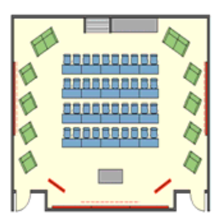

21st Century Learning Outcomes

- Non-routine problem-solving
- Adaptability
- Complex social/ communication skills
- Self-management/self-development
- Systems thinking

—Exploring the Intersection of Science Education and 21st Century Skills. NAS. 2010

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How People Learn

People learn best when they are:

- actively engaged in constructing their own knowledge
- situated in a social and supportive community
- able to reflect and build on prior knowledge
- involved with addressing problems that are relevant to their lives and work.

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Bureau of Labor Statistics

Occupational Outlook Handbook, 2008 – 2009

Teachers:

- …act as facilitators or coaches.
- …use a 'hands-on' approach…to help students understand abstract concepts, solve problems, and develop critical thought processes.
- …encourage collaboration in solving problems by having students work in groups to discuss and solve problems.
- …[understand that] to be prepared for success late in life, students must be able to interact with others, adapt to new technology, and think through problems logically.

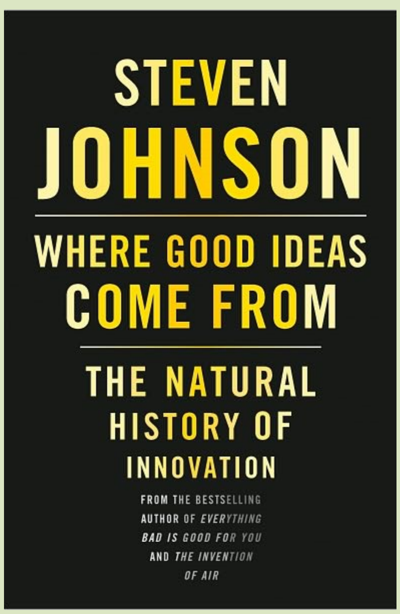
5 5

Transparent Beauty
By Robert L. Reid

The 163,000 sq ft extension to the Massachusetts Institute of Technology's Media Lab provides a beautiful example of ***how a building's design can promote interaction and collaboration*** *among the people working within its walls.*

Reflection and Dialogue

- Individually reflect on Building Design and Space Planning Practices that support and foster Interaction and Collaboration. Write for about 1 minute
- Discuss with your neighbor for about 3 minutes
  - Select one Practice, Insight, Success Story, Comment, Question, etc. that you would like to present to the whole group if you are randomly selected
- Whole group discussion



This is a book about the space of innovation. Some environments squelch new ideas; some environments seem to breed them effortlessly (p. 19).

What kind of environment creates good ideas? The simplest way to answer it is this: innovative environments are better at helping their inhabitants **explore the adjacent possible** .. (p. 36).

Our thought shapes the spaces we inhabit, and our spaces return the favor. The argument in this book is that a series of **shared properties** and patterns recur again and again in unusually fertile environments (p. 20).

Where Good Ideas Come From

seven shared properties and patterns

- The adjacent possible
- Liquid networks
- The slow hunch
- Serendipity
- Error
- Exapation (type of borrowing – Stephen Jay Gould & Elisabeth Vrba, 1971, e.g., Gutenberg's printing press – classic combinatorial innovation, more bricolage than breakthrough)
- Platforms

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]

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Student Engagement Research Evidence

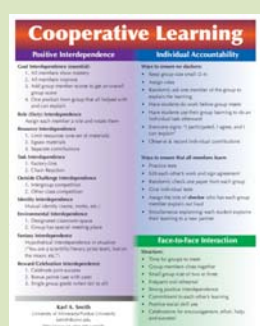
- Perhaps the strongest conclusion that can be made is the least surprising. Simply put, the greater the student's involvement or engagement in academic work or in the academic experience of college, the greater his or her level of knowledge acquisition and general cognitive development …(Pascarella 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 Research Support

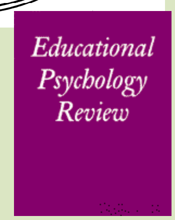
Johnson, D.W., Johnson, R.T., & Smith, K.A. 1998. Cooperative learning returns to college: What evidence is there that it works? *Change*, *30* (4), 26-35.

- 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

Active and Cooperative Learning

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)
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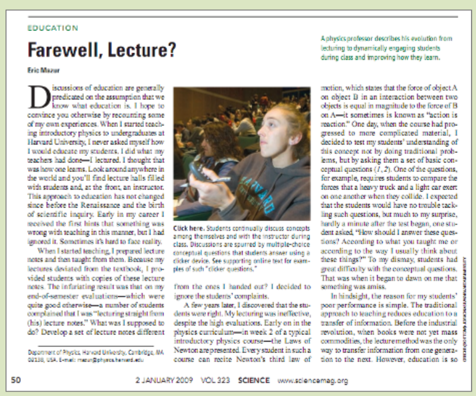
SINGLE PAGE

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?

Eric Mazur

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

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.

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

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."

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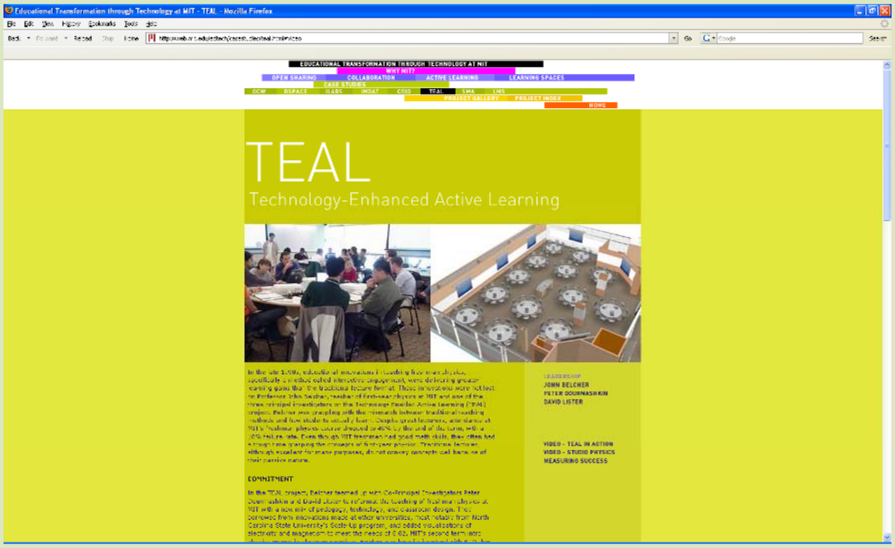
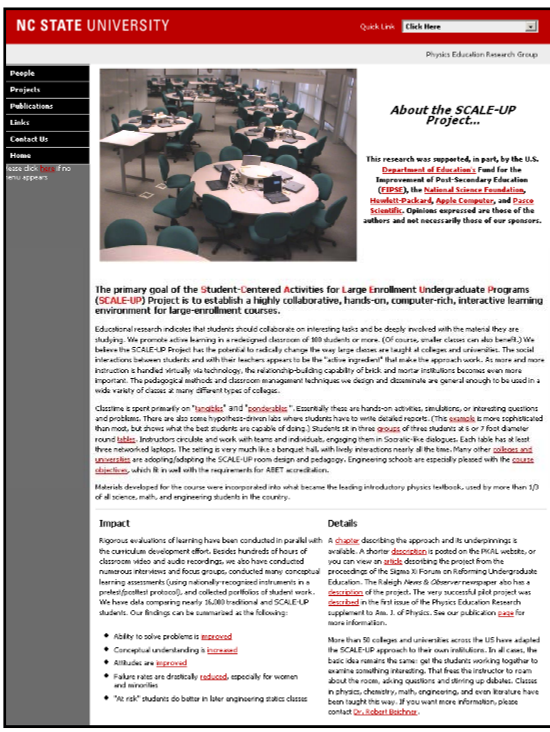
50 2 JANUARY 2009 VOL 323 SCIENCE www.sciencemag.org

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

Calls for evidence-based promising practices



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



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

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

High Performance Teams

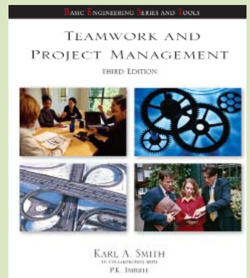
Top Three Main Engineering Work Activities

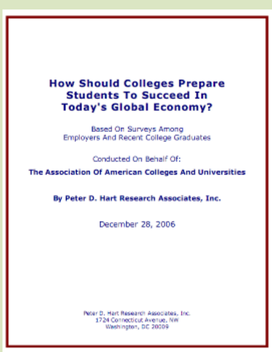
Engineering Total

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

Civil/Architectural

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





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

Design team failure is usually due to failed team dynamics

(Leifer, Koseff & Lenshow, 1995).

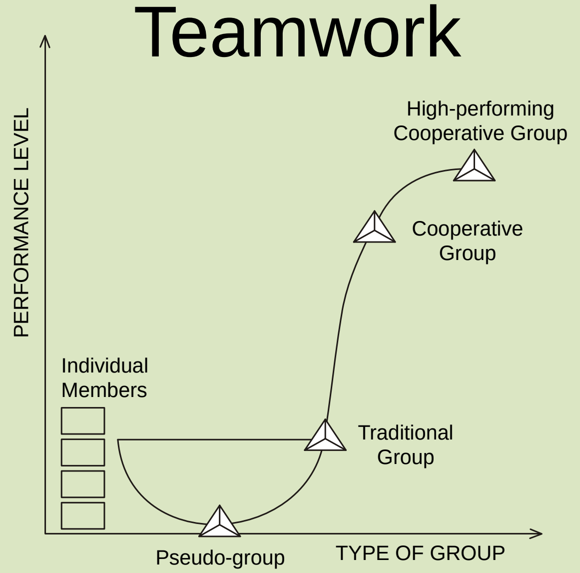
It's the soft stuff that's hard, the hard stuff is easy

(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



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Characteristics of High Performing Teams

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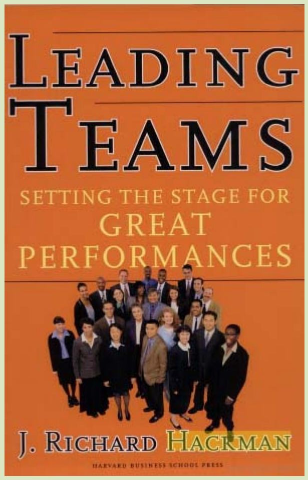
- ?

A team is 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/

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Real Team

- clear boundaries
- team members are interdependent for some common purpose, producing a potentially assessable outcome for which members bear collective responsibility
- at least moderate stability of membership

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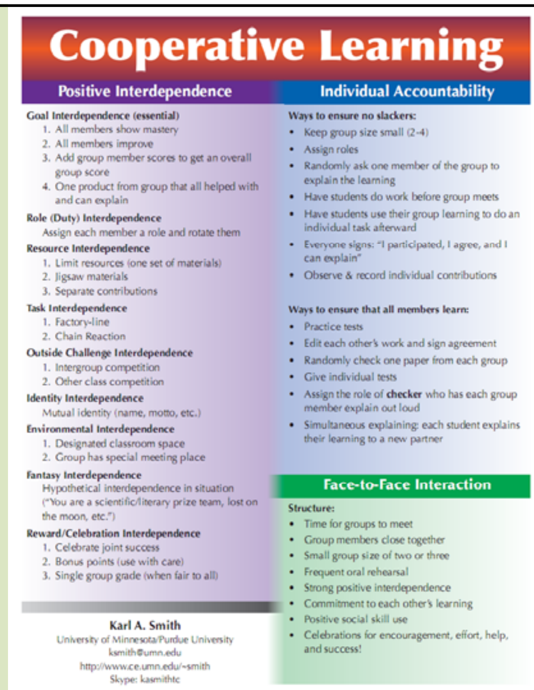

Cooperative Learning

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
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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

Teamwork Skills

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

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Team Charter

- Team name, membership, and roles
- Team Mission Statement
- Anticipated results (goals)
- Specific tactical objectives
- **Ground rules/Guiding principles for team participation**
- Shared expectations/aspirations

Code of Cooperation

- EVERY member is responsible for the team's progress and success.
- Attend all team meetings and be on time.
- Come prepared.
- Carry out assignments on schedule.
- Listen to and show respect for the contributions of other members; be an active listener.
- CONSTRUCTIVELY criticize ideas, not persons.
- Resolve conflicts constructively,
- Pay attention, avoid disruptive behavior.
- Avoid disruptive side conversations.
- Only one person speaks at a time.
- Everyone participates, no one dominates.
- Be succinct, avoid long anecdotes and examples.
- No rank in the room.
- Respect those not present.
- Ask questions when you do not understand.
- Attend to your personal comfort needs at any time but minimize team disruption.
- HAVE FUN!!
- ?

Adapted from Boeing Aircraft Group Team Member Training Manual

Ten Commandments: An Affective Code of Cooperation

- Help each other be right, not wrong.
- Look for ways to make new ideas work, not for reasons they won't.
- If in doubt, check it out! Don't make negative assumptions about each other.
- Help each other win, and take pride in each other's victories.
- Speak positively about each other and about your organization at every opportunity.
- Maintain a positive mental attitude no matter what the circumstances.
- Act with initiative and courage, as if it all depends on you.
- Do everything with enthusiasm; it's contagious.
- Whatever you want; give it away.
- Don't lose faith.
- Have fun

Ford Motor Company

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Group Ground Rules Contract Form

(Adapted from a form developed by Dr. Deborah Allen, University of Delaware)

Project groups are an effective aid to learning, but to work best they require that all groups members clearly understand their responsibilities to one another. These project group ground rules describe the general responsibilities of every member to the group. You can adopt additional ground rules if your group believes they are needed. Your signature on this contract form signifies your commitment to adhere to these rules and expectations.

All group members agree to:

1. Come to class and team meetings on time.
2. Come to class and team meetings with assignments and other necessary preparations done.

Additional ground rules:

1.

2.

If a member of the project team repeatedly fails to meet these ground rules, other members of the group are expected to take the following actions:

Step 1: (fill in this step with your group)

If not resolved:

Step 2: Bring the issue to the attention of the teaching team.

If not resolved:

Step 3: Meet as a group with the teaching team.

The teaching team reserves the right to make the final decisions to resolve difficulties that arise within the groups. Before this becomes necessary, the team should try to find a fair and equitable solution to the problem.

Member's Signatures: Group Number:______________

1.__________________________ 3.__________________________

2.__________________________ 4.__________________________

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Group Processing
Plus/Delta Format

Plus (+) Things That Group Did Well	Delta (Δ) Things Group Could Improve

Design and Implementation of Cooperative Learning – Resources

- Design Framework – How People Learn (HPL) & Backward Design Process
  - Creating High Quality Learning Environments (Bransford, Vye & Bateman) -- http://www.nap.edu/openbook/0309082927/html/
  - 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.
- 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.
- Active and Cooperative Learning - Instructional Format explanation and exercise to model format and to engage workshop participants
  - 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]
  - 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

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Skills: Hard Workers

From Boeing Aircraft Group Team Member Training Manual (Excerpts):

- EVERY member is responsible for the team's progress and success.
- Listen to and show respect for the contributions of other members; be an active listener.
- CONSTRUCTIVELY criticize ideas, not persons.
- Only one person speaks at a time.
- Everyone participates; no one dominates.
- Be succinct—avoid long anecdotes and examples.
- No rank in the room.
- Ask questions when you do not understand.
- Attend to your personal comfort needs at any time, but minimize team disruption.
- HAVE FUN!!

Communities of practice are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise…by interacting on an ongoing basis.

— Wenger, etal. Communities of Practice. 2002

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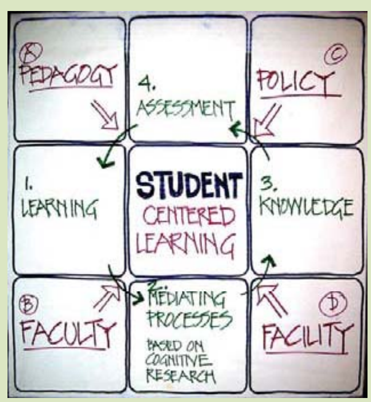
Skills: Systems Thinkers

Leadership is present where we find people working together believing their cooperative efforts will lead to improvements in the system for everyone and to systemic change.



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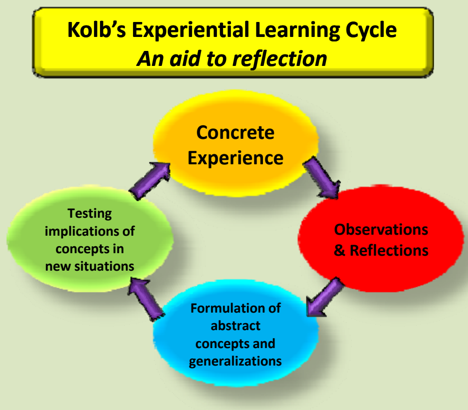
Reflecting Communities



Consider the experience of dancing on a dance floor in contrast with standing on a balcony and watching other people dance... To discern the larger patterns on the dance floor…we have to stop moving and get to the balcony.

— Ronald A. Heifetz, Leadership Without Easy Answers. The Belknap Press of Harvard University Press, 1994.

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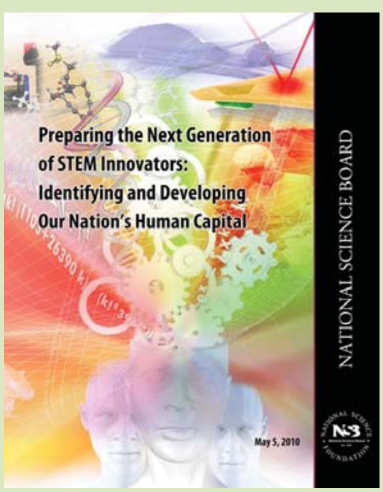
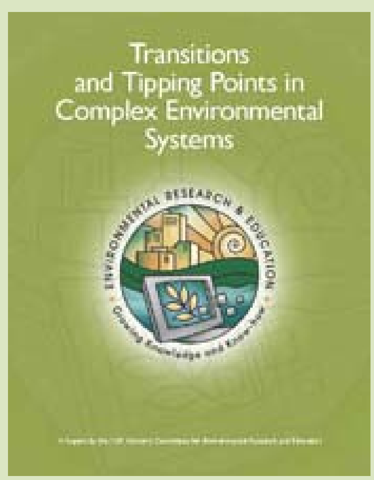
2009/2010 Reports





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What students are able to do
What students are able to be

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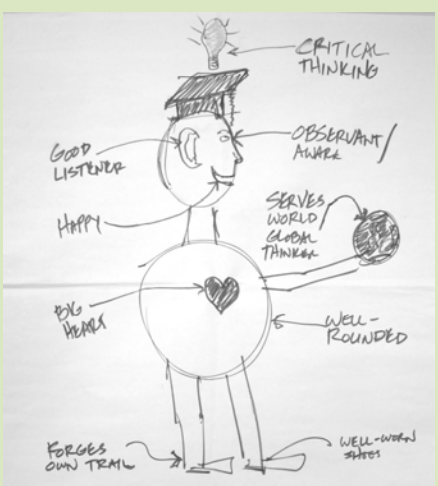
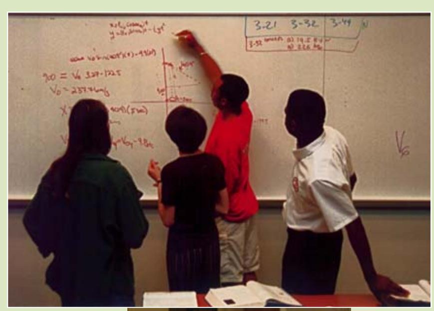
The PKAL Vision
The Ideal Learners





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