Informal Cooperative Learning – Design, Implementation and Assessment

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Session Layout

- Welcome & Overview
- Pedagogies of Engagement – Cooperative Learning and Challenge Based Learning
  - **Informal Cooperative Learning** – Bookends on a Class Session
  - Formal Cooperative Learning
- Design and Implementation

Participant Learning Goals (Objectives)

- Describe key features of Cooperative Learning
- Explain rationale for Pedagogies of Engagement, especially Cooperative Learning & Challenge Based Learning
- Describe key features of the Understanding by Design and How People Learn
- 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 practice of Informal Cooperative Learning (or Active Learning). Write for about 1 minute
  - Key ideas, insights, applications – Success Stories
  - Questions, concerns, challenges
- Discuss with your neighbor for about 2 minutes
  - Select one Insight, Success Story, Comment, Question, etc. that you would like to present to the whole group if you are randomly selected

Pedagogies of Engagement

Cooperative Learning Introduced to Engineering – 1981

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

Structuring Learning Goals
To Meet the Goals of
Engineering Education

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

JEE December 1981

Pedagogies of Engagement: Classroom-Based Practices

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ABSTRACT

Educators, researchers, and policy makers have advocated student involvement for some time as an essential aspect of meaningful learning. In the past twenty years engineering educators have implemented several means of better engaging their undergraduate students, including active and cooperative learning, learning communities, service learning, cooperative education, inquiry and problem-based learning, and team projects. This paper focuses on classroom-based pedagogies of engagement, particularly cooperative and problem-based learning. It includes a brief history, theoretical roots, research support, summary of practices, and suggestions for redesigning engineering classes and programs to include more student engagement. The paper also lays out the research related for advancing pedagogies aimed at more fully enhancing students' involvement in their learning.

Keywords: cooperative learning, problem-based learning, student engagement

I. INTRODUCTION TO THE PEDAGOGIES OF ENGAGEMENT

Russ Edgerton introduced the term "pedagogies of engagement" in his 2001 *Education White Paper* [1], in which he reflected on the projects on higher education funded by the Pew Charitable Trusts. He wrote:

"Throughout the whole enterprise, the core issue, in my view, is the mode of teaching and learning that is practiced. Learning 'about' things does not enable students to acquire the abilities and understanding they will need for the twenty-first century. We need new pedagogies of engagement that will turn out the kinds of resourceful, engaged workers and citizens that America now requires."

Prior to Edgerton's paper, the widely distributed and influential publication called *The Seven Principles for Good Practice in Undergraduate Education* [2] stressed pedagogies of engagement in concept. Those of the principles, speak directly to pedagogies of engagement, namely, that good practice encourages student-faculty contact, cooperation among students, and active learning.

More recently, the project titled The National Survey of Student Engagement (NSSE) [3] deepens our understanding of how students perceive classroom-based learning, as well as learning, and engagement in the larger issue of student engagement in their college education. The NSSE project conceives that student engagement is not just a single course in a student's academic career, but rather a pattern of his or her involvement in a variety of activities. As such, NSSE findings are a valuable assessment tool for colleges and universities to track how successful their academic practices are in engaging their student bodies. The NSSE project is grounded in the proposition that student engagement, the frequency with which students participate in activities that represent effective educational practice, is a meaningful proxy for collegiate quality and, therefore, by extension, quality of education. The annual survey of freshmen and seniors asks students how often they have, for example, participated in projects that required integrating ideas or information from various sources, used e-mail to communicate with an instructor, asked questions in class or contributed to class discussions, received prompt feedback from faculty on their academic performance, participated in community-based projects, or tutored or taught other students. Student responses are organized around five benchmarks:

1. *Level of academic challenge.* Schools encourage achievement by setting high expectations and emphasizing importance of student effort.
2. *Active and collaborative learning.* Students learn more when intensively involved in educational process and are encouraged to apply their knowledge in many situations.
3. *Student-faculty interaction.* Students able to learn from experts and faculty serve as role models and mentors.
4. *Enriching educational experiences.* Learning opportunities inside and outside classroom (diversity, technology, collaboration, internships, community service, capstones) enhance learning.
5. *Supportive campus environment.* Students are motivated and satisfied at schools that actively promote learning and stimulate social interaction.

Astin's [4] large-scale correlational study of what matters in college (involving 25,064 students at 309 baccalaureate-granting institutions) found that two environmental factors were by far the most predictive of positive change in college students' academic development, personal development, and satisfaction. These two factors—interaction among students and interaction between faculty and

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Russ Edgerton (reflecting on higher education projects funded by the Pew Memorial Trust)

http://www.asee.org/publications/jee/issueList.cfm?year=2005#January2005

Cooperative Learning Adopted

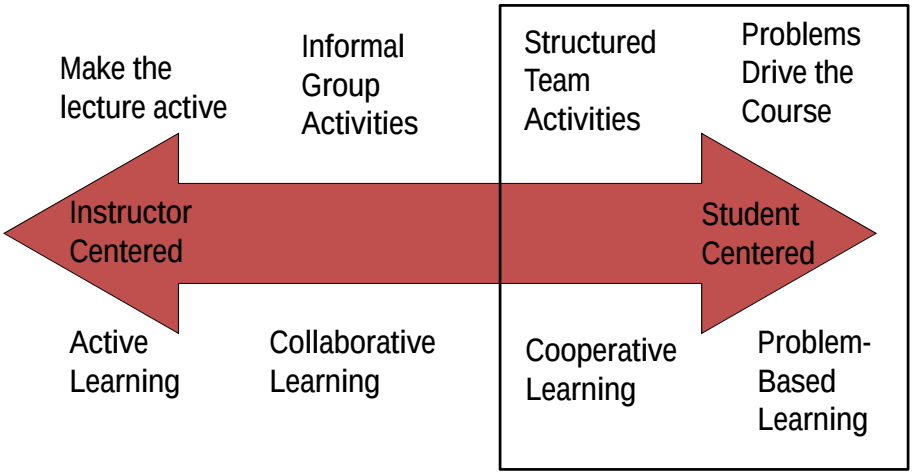
The American College Teacher:

National Norms for 2007-2008

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

http://www.heri.ucla.edu/index.php

The Active Learning Continuum



Prince, M. (2010). NAE FOEE

Workshop is situated here – Cooperative Learning & Challenge-Based Learning

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).

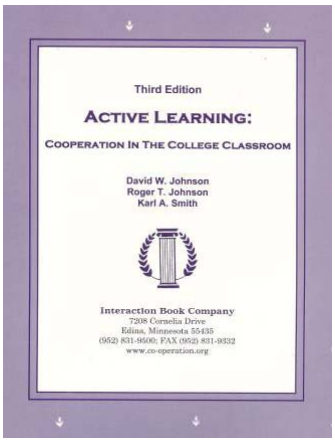
Key Concepts

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

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

Active Learning: Cooperation in the College Classroom

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



Notes: Cooperative Learning Handout (CL College-804.doc)

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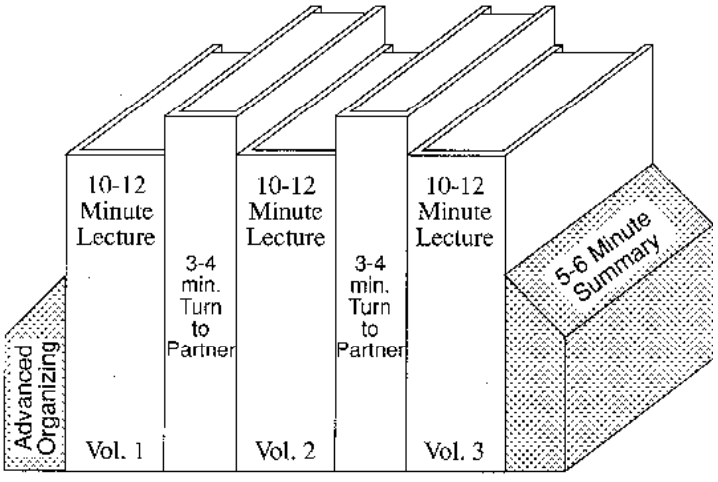
Book Ends on a Class Session



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

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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.

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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.

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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

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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.

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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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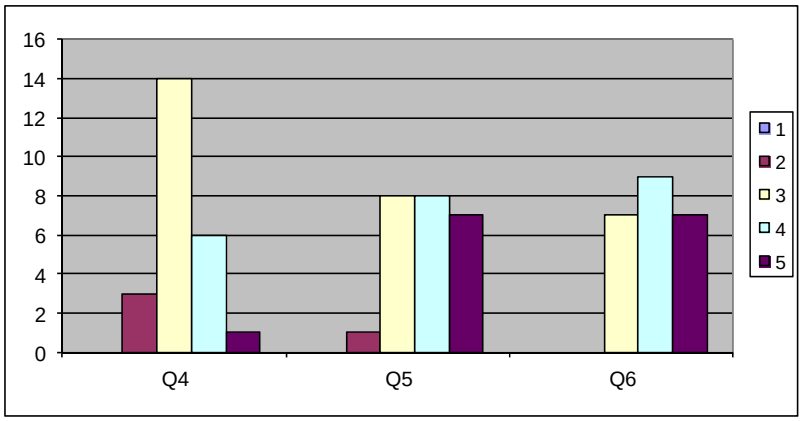
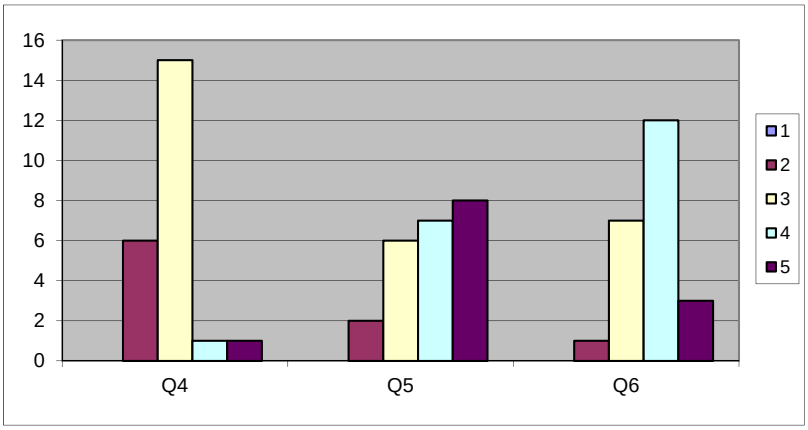
MOT 8221 – Spring 2012 – Session 1 (1/6/12)



Q4 – Pace: Too slow 1 . . . . 5 Too fast (3.2)
Q5 – Relevance: Little 1 . . . 5 Lots (3.9)
Q6 – Format: Ugh 1 . . . 5 Ah (4.0)

MOT 8221 – Spring 2011 – Session 1 (3/25/11)



Q4 – Pace: Too slow 1 . . . . 5 Too fast (2.9)
Q5 – Relevance: Little 1 . . . 5 Lots (3.9)
Q6 – Format: Ugh 1 . . . 5 Ah (3.7)

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

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

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

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

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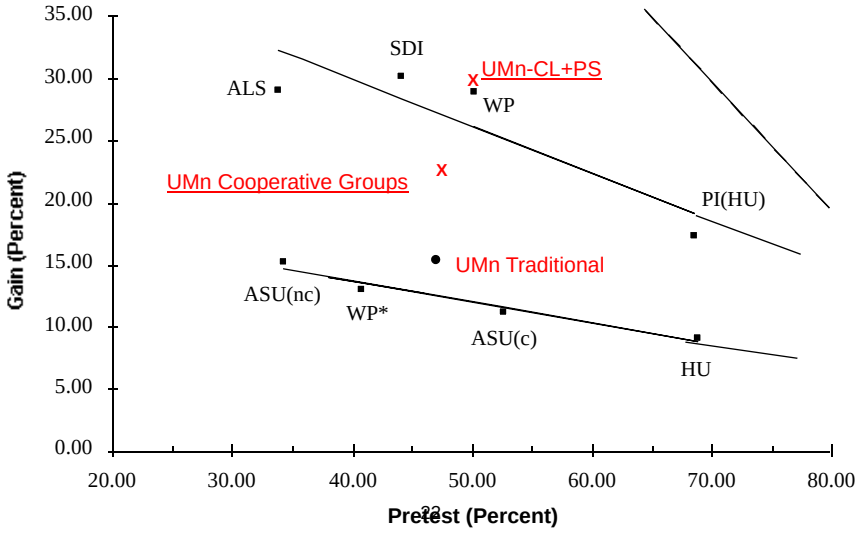
The "Hake" Plot of FCI



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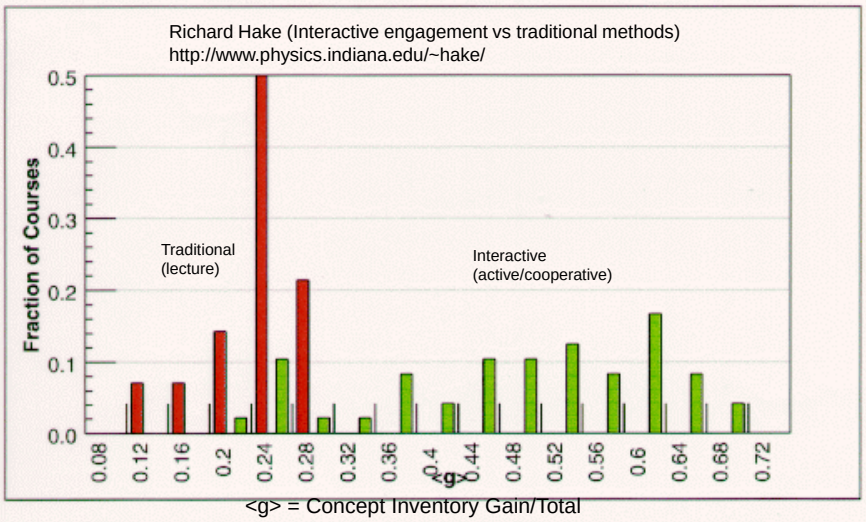
Richard Hake (Interactive engagement vs traditional methods)
http://www.physics.indiana.edu/~hake/



<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.

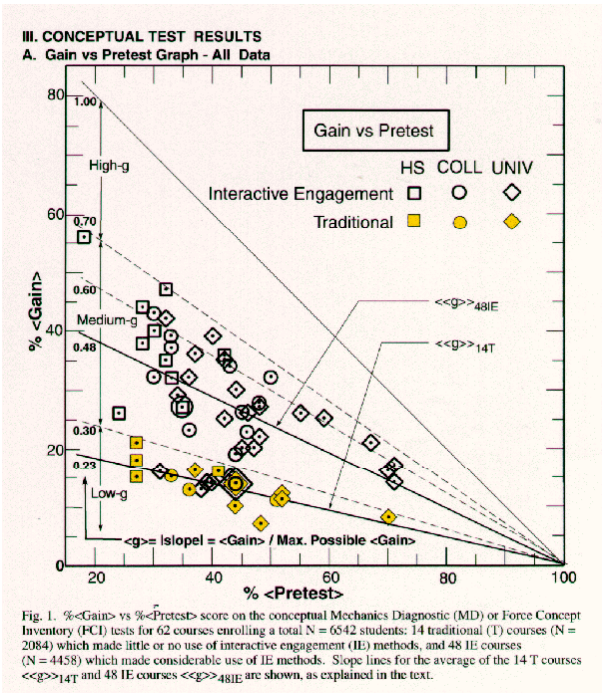


Fig. 1. %<Gain> vs %<Pretest> score on the conceptual Mechanics Diagnostic (MD) or Force Concept Inventory (FCI) tests for 62 courses enrolling a total N = 6542 students: 14 traditional (T) courses (N = 2084) which made little or no use of interactive engagement (IE) methods, and 48 IE courses (N = 4458) 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.

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.

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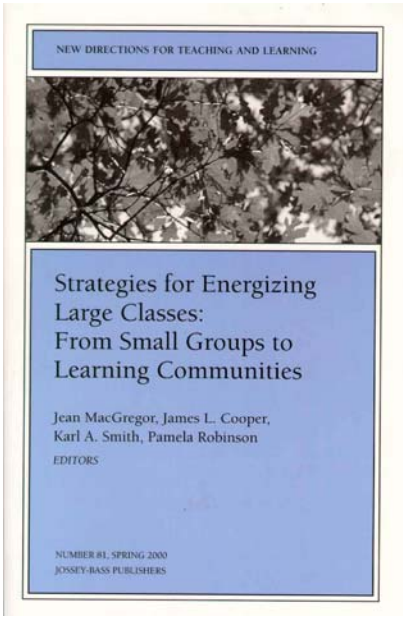
Informal Cooperative Learning Groups

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



Strategies for Energizing Large Classes: From Small Groups to Learning Communities:

Jean MacGregor,
James Cooper,
Karl Smith,
Pamela Robinson

New Directions for Teaching and Learning, No. *81*, 2000.
Jossey- Bass

Informal Cooperative Learning Planning Form

DESCRIPTION OF THE LECTURE

1. **Lecture Topic:** _____
2. **Objectives** (Major Understandings Students Need To Have At The End Of The Lecture):
   a. _____
   b. _____
3. **Time Needed:** _____
4. **Method For Assigning Students To Pairs Or Triads:** _____
5. **Method Of Changing Partners Quickly:** _____
6. **Materials** (such as transparencies listing the questions to be discussed and describing the **formulate, share, listen, create** procedure):
   _____

ADVANCED ORGANIZER QUESTION(S)

Questions should be aimed at promoting **advance organizing** of what the students know about the topic to be presented and **establishing expectations** as to what the lecture will cover.

1. _____
2. _____
3. _____

COGNITIVE REHEARSAL QUESTIONS

List the specific questions to be asked every 10 or 15 minutes to ensure that participants understand and process the information being presented. Instruct students to use the **formulate, share, listen, and create** procedure.

1. _____
2. _____
3. _____
4. _____

Monitor by systematically observing each pair. Intervene when it is necessary. Collect data for whole class processing. Students' explanations to each other provide a window into their minds that allows you to see what they do and do not understand. Monitoring also provides an opportunity for you to get to know your students better.

SUMMARY QUESTION(S)

Give an ending discussion task and require students to come to consensus, write down the pair or triad's answer(s), sign the paper, and hand it in. Signatures indicate that students agree with the answer, can explain it, and guarantee that their partner(s) can explain it. The questions could (a) ask for a summary, elaboration, or extension of the material presented or (b) precue the next class session.

1. _____
2. _____

CELEBRATE STUDENTS' HARD WORK

1. _____
2. _____

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Design and Implementation of Cooperative Learning – Resources

- Design Framework – How People Learn (HPL) & Backward Design Process
  - Streveler, R.A., Smith, K.A. and Pilotte, M. 2011. Aligning Course Content, Assessment, and Delivery: Creating a Context for Outcome-Based Education – http://www.ce.umn.edu/~smith/links.html
  - Bransford, Vye & Bateman. 2002. Creating High Quality Learning Environments -- 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.
- 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