Design and Implementation of Active and Cooperative Learning in Large Classrooms

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4th Annual Best Practice Institute
Teaching and Learning in Health Professions Education

University of Minnesota

May 18, 2009
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]
Workshop Layout

• Welcome & Overview
• Integrated Course Design (CAP Model)
  – Content
  – Assessment
  – Pedagogy
• Active & Cooperative Learning
  – Informal – Bookends on a Class Session
  – Formal – Problem-Based Cooperative Learning
    • Design and Teamwork Features
• Wiggins & McTighe Backward Design Approach – Course, Class or Lab Session, and Learning Module Design: From Objectives and Evidence to Instruction
• Wrap-up and Next Steps
Session Objectives

• Participants will be able to
  – Explain rationale for Active and Cooperative Learning
  – Describe key features of Cooperative Learning
  – Apply cooperative learning to classroom practice
  – Identify connections between cooperative learning and desired outcomes of courses and programs
Background Knowledge Survey

• Familiarity with
  – Approaches to Course Design
    • Felder & Brent – Effective Course Design
    • Fink – Creating Significant Learning Experiences
    • Wiggins & McTighe – Understanding by Design (Backward Design)
  – Active and Cooperative Learning Strategies
    • Informal – turn-to-your-neighbor
    • Formal – cooperative problem-based learning
  – Research
    • Student engagement – NSSE
    • Cooperative learning
    • How People Learn

• Responsibility
  – Individual course
  – Program
  – Accreditation
Effective Course Design

Goals and Objectives

ABET EC 2000

(Felder & Brent, 1999)

Course-specific goals & objectives

Bloom’s Taxonomy

Technology

Cooperative learning

Students

Instruction

Assessment

Instruction

Lectures

Labs

Other experiences

Lectures

Labs

Other experiences

Assessment

Tests

Other measures

Classroom assessment techniques

Technology

Cooperative learning
Integrated Course Design (Fink, 2003)

Initial Design Phase

1. Situational Factors
2. Learning Goals
3. Feedback and Assessment
4. Teaching/Learning Activities
5. Integration

CAP Design Process Flowchart

Start

Context

Content

Assessment

Pedagogy

C & A & P Alignment?

Yes
End

No
CAP Design Process (Shawn’s Model)

- Start
- Context
- Content
- Pedagogy
- Assessment
- End

Cloud of alignment
Resources

- Bransford, Vye and Bateman – Creating High Quality Learning Environments
  
- Pellegrino – Rethinking and Redesigning Curriculum, Instruction and Assessment

http://books.nap.edu/openbook.php?record_id=10239&page=159

http://www.skillscommission.org/commissioned.htm
Designing Learning Environments Based on HPL (How People Learn)
Backward Design
Wiggins & McTighe

Stage 1. Identify Desired Results

Stage 2. Determine Acceptable Evidence

Stage 3. Plan Learning Experiences and Instruction

Goal – All students have access to supportive, excellent undergraduate education in science, mathematics, engineering, and technology, and all students learn these subjects by direct experience with the methods and processes of inquiry.

Recommend that SME&T faculty: Believe and affirm that every student can learn, and model good practices that increase learning; starting with the student’s experience, but have high expectations within a supportive climate; and build inquiry, a sense of wonder and the excitement of discovery, plus communication and teamwork, critical thinking, and life-long learning skills into learning experiences.
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

What do we do about these pathologies?
– Lee Shulman

Activity
Reflection
Collaboration
Passion

Pedagogies of Engagement
MIT & Harvard - Engaged Pedagogies

Calls for evidence-based teaching practices

January 2, 2009—Science, Vol. 323

http://www.sciencemag.org

January 13, 2009—New York Times

TEAL
Technology-Enhanced Active Learning

http://web.mit.edu/edtech/casestudies/teal.html#video
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 huddled virtually, the relationship-building capability of back and mortar institutions become 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.

Classrooms are spontaneously or "natural" and "condensed". Essentially there are hands-on activities, simulations, or interesting questions and problems. There are also some hypothesis-driven labs where students have to write detailed reports. (The students is more sophisticated than most, but show 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 networking laptops. The setting is very much like a banquet hall, with nearly 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 well with the requirements for ABET accreditation.

Materials developed for the course were incorporated into what became the leading introductory physics textbooks used by more than 50% of all science, math, and engineering students in the country.

http://www.ncsu.edu/PER/scaleup.html
https://repo.vanth.org/portal/public-content/star-legacy-cycle/star-legacy-cycle
Cooperative Learning
• Positive Interdependence
• Individual and Group Accountability
• Face-to-Face Promotive Interaction
• Teamwork Skills
• Group Processing
Cooperative Learning Research Support

• 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
• **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

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 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
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!

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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?
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
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 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
Most Important Skills Employers Look For In New Hires

Which TWO of the following skills or abilities are most important to you?

- Teamwork skills: 44%
- Critical thinking/reasoning: 33%
- Oral/written communication: 30%
- Ability to assemble/organize information: 21%
- Innovative/thinking creatively: 20%
- Able to work with numbers/statistics: 9%
- Foreign language proficiency: 3%

* Skills/abilities recent graduates think are the two most important to employers

Recent
Grads*

38%
37%
37%
10%
21%
4%
6%

Top Three Main Engineering Work Activities

**Engineering Total**
- Design – 36%
- Computer applications – 31%
- Management – 29%

**Civil/Architectural**
- Management – 45%
- Design – 39%
- Computer applications – 20%

Teamwork Skills

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

PERFORMANCE LEVEL

TYPE OF GROUP

Individual Members

Pseudo-group

Traditional Group

Cooperative Group

High-performing Cooperative Group
Characteristics of Effective Teams

• ?
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/
Group Processing
Plus/Delta Format

Plus (+)
Things That Group Did Well

Delta (Δ)
Things Group Could Improve
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
https://repo.vanth.org/portal/public-content/star-legacy-cycle/star-legacy-cycle
Kolb’s Experiential Learning Cycle

Concrete Experience

Testing implications of concepts in new situations

Observation and Reflections

Formulation of abstract concepts and generalizations
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 posed

Identify what we need to know

Learn it

Apply it

START

52
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.

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 Duck

PBL2002:
A Pathway to Better Learning

Recipient of 1999 Hesburgh Certificate of Excellence

Please direct comments, suggestions, or requests to ud-pbl@udel.edu

"http://www.udel.edu/pbl/
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http://www.udel.edu/pbl/
Backward Design Model
Wiggins & McTighe

Stage 1. Identify Desired Results

Stage 2. Determine Acceptable Evidence

Stage 3. Plan Learning Experiences and Instruction

Backward Design

Stage 1. Identify Desired Results

Filter 1. To what extent does the idea, topic, or process represent a big idea or having enduring value beyond the classroom?

Filter 2. To what extent does the idea, topic, or process reside at the heart of the discipline?

Filter 3. To what extent does the idea, topic, or process require uncoverage?

Filter 4. To what extent does the idea, topic, or process offer potential for engaging students?
Backward Design Approach:

• Desired Results (Outcomes, Objectives, Learning Goals)
  – 5 minute university

• Evidence (Assessment)
  – Learning Taxonomies

• Plan Instruction
  – Cooperative Learning Planning Format & Forms
<table>
<thead>
<tr>
<th>The Knowledge Dimension</th>
<th>Remember</th>
<th>Understand</th>
<th>Apply</th>
<th>Analyze</th>
<th>Evaluate</th>
<th>Create</th>
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<tr>
<td><strong>Factual Knowledge</strong> – The basic elements that students must know to be acquainted with a discipline or solve problems in it.</td>
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<td>a. Knowledge of terminology</td>
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<td>b. Knowledge of specific details and elements</td>
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<td><strong>Conceptual Knowledge</strong> – The interrelationships among the basic elements within a larger structure that enable them to function together.</td>
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<td>a. Knowledge of classifications and categories</td>
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<td>b. Knowledge of principles and generalizations</td>
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<td>c. Knowledge of theories, models, and structures</td>
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<td><strong>Procedural Knowledge</strong> – How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.</td>
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<td>a. Knowledge of subject-specific skills and algorithms</td>
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<td>b. Knowledge of subject-specific techniques and methods</td>
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<td>c. Knowledge of criteria for determining when to use appropriate procedures</td>
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<td><strong>Metacognitive Knowledge</strong> – Knowledge of cognition in general as well as awareness and knowledge of one’s own cognition.</td>
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<td>a. Strategic knowledge</td>
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<td>b. Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge</td>
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<td>c. Self-knowledge</td>
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</table>

A taxonomy for learning, teaching, and assessing: A revision of Bloom’s taxonomy of educational objectives (Anderson & Krathwohl, 2001).
Taxonomies

Bloom’s taxonomy of educational objectives: Cognitive Domain (Bloom & Krathwohl, 1956)

A taxonomy for learning, teaching, and assessing: A revision of Bloom’s taxonomy of educational objectives (Anderson & Krathwohl, 2001).

Evaluating the quality of learning: The SOLO taxonomy (Biggs & Collis, 1982)

Facets of understanding (Wiggins & McTighe, 1998)

Taxonomy of significant learning (Fink, 2003)

A taxonomic trek: From student learning to faculty scholarship (Shulman, 2002)
Backward Design

Stage 2. Determine Acceptable Evidence

Types of Assessment

Quiz and Test Items:
Simple, content-focused test items

Academic Prompts:
Open-ended questions or problems that require the student to think critically

Performance Tasks or Projects:
Complex challenges that mirror the issues or problems faced by graduates, they are authentic
Backward Design

Stage 3. 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?
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]
Design and Implementation of Cooperative Learning – Resources

• Design Framework – How People Learn (HPL)
  – Creating High Quality Learning Environments (Bransford, Vye & Bateman) --
    http://www.nap.edu/openbook/0309082927/html/

• Design & Backward Design Process (Felder & Brent, Dee Fink and Wiggins & McTighe)
  – Pellegrino – Rethinking and redesigning curriculum, instruction and assessment:
    What contemporary research and theory suggests.
    http://www.skillscommission.org/commissioned.htm

• Content Resources
  – 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.

• Pedagogies of Engagement - 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
  – University of Delaware PBL web site – www.udel.edu/pbl
  – PKAL – Pedagogies of Engagement –
    http://www.pkal.org/activities/PedagogiesOfEngagementSummit.cfm