Welcome to the SDSU ASEE Best Practices in Engineering Education Series

• Today’s Topic: Problem-Based Cooperative Learning

• Help yourself to pizza / water
Problem-Based Cooperative Learning

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Estimation Exercise
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
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
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
Decisions, Decisions

Group size?
Group selection?
Group member roles?
How long to leave groups together?
Arranging the room?
Providing materials?
Time allocation?
Formal Cooperative Learning Task Groups

Ping Pong Ball Exercise

• Form Teams of 3 students

• Decide on Team Member Roles
  – Observer/ Process Recorder
  – Task Recorder
  – Skeptic/Prober
Ping Pong Ball Exercise

**TASK:** Determine how many ping-pong balls will fit in this room.

1) Individually, in 15 seconds

2) As a group, in 5 minutes. Record your method for determining answer. The Task Recorder should document your process.
Ping Pong Ball Exercise

The Answer must be COOPERATIVE: One answer from the group, everyone has to agree, everyone has to be able explain the group's answer.
Ping Pong Ball Exercise

CRITERIA FOR SUCCESS: Best answer given available resources.

INDIVIDUAL ACCOUNTABILITY: Several group members will be randomly selected to present their group's answer and method.
Ping Pong Ball Exercise

**EXPECTATIONS:** Everyone participates, check for understanding among the group.
Ping Pong Ball Exercise

INTERGROUP COOPERATION: When finished compare answer with the answers of surrounding groups in an unintrusive way
Technical Estimation Exercise

TASK:

INDIVIDUAL: Quick Estimate (10 seconds). Note strategy.

COOPERATIVE: Improved Estimate (15 minutes). One set of answers from the group, strive for agreement, make sure everyone is able to explain the strategies used to arrive at the improved estimate.

EXPECTED CRITERIA FOR SUCCESS: Everyone must be able to explain the strategies used to arrive at your improved estimate.

EVALUATION: Best answer within available resources or constraints.

INDIVIDUAL ACCOUNTABILITY: One member from your group may be randomly chosen to explain (a) your estimate and (b) how you arrived at it.

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.
What Students Learn

• Since reflection is an integral part of the process of building models to solve problems with students, we periodically ask students to step back and reflect, "What did you learn about modeling from this exercise?"
What Students Learn

As the students contribute their insights, we typically look for and refine the following points:

1. Both the one-minute and five-minute exercises illustrate the point that a model is a partial rather than a complete representation.

2. Even a very rough answer is better than no answer at all. We encourage student to come up with the best answer within the available resources. Often a range (the answer is between -- and --) is better than a single number.
What Students Learn

3. A model that is inadequate under one set of circumstances may be the best that you can do under another set of circumstances. It follows that the design of a model depends as much on circumstances and constraints (of money, time, data or personnel) as it does on the problem that is being solved. It also follows that the assumptions one makes depend on the circumstances in which one solves the problem.

4. A symbolic representation (choosing a notation and building a formula or formulae) is 'clean' and powerful. It communicates, simply and clearly, what the modeler believes is important, what information is needed and how that information will be used.
What Students Learn

5. Sometimes one uses models implicitly (without being aware that one is doing so); at other times one consciously or explicitly constructs or uses a model. An explicit model is an indispensable tool for solving problems and for talking about the solution.
Real World

Model World

Model

$V_r/V_b$

Calculations
Subject-Based Learning

Typical Professional Curriculum:

1. Teach the relevant basic science,

2. Teach the relevant applied science, and

3. Allow for a practicum to connect the science to actual practice.
Problem-Based Learning

START

Problem posed

Identify what we need to know

Learn it

Apply it
Problem-Based Learning (PBL)

Problem-based learning is the learning that results from the process of working toward the understanding or resolution of a problem. The problem is encountered first in the learning process - Barrows and Tamlyn, 1980

Core Features of PBL

• Learning is student-centered
• Learning occurs in small student groups
• Teachers are facilitators or guides
• Problems are the organizing focus and stimulus for learning
• Problems are the vehicle for the development of clinical problem-solving skills
• New information is acquired through self-directed learning
Some ways to assess student work – done by the students themselves

Group Processing
Plus/Delta Format

Plus (+)
Things That Group Did Well

Delta (Δ)
Things Group Could Improve
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<th>Action</th>
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<td>Checks for Understanding</td>
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"How to Model It... it is a serious attempt to teach modeling. 
... it's the best I've seen on the subject."

CONTENTS

1 Introducing Models (and this book)
   A model of the book, showing how it differs from most books.

2 Time for Ping-Pong?
   How approach and solutions depend on resources.

3 Purging a Gas Storage Tank
   Using heuristics and tools such as spreadsheets.

4 The Case of the Hot and Thirsty Executive
   Interpreting results and presenting solutions.

5 Tennis, Anyone?
   Introduction to decision making under risk: probability and stochastic
   modeling.

6 Food for Thought
   The importance of organizing and representing information.

7 The Student's Dilemma: French, Calculus, Time, and Money
   A resource allocation problem. Introduction to optimization.

8 A Cab Control System
   Using models to explore system dynamics. Modeling and design.

9 The Case of the Dishonest Advertiser
   Developing and comparing strategies: exploring trade-offs.

10 The Librarian's Dilemma
    Qualitative knowledge models. Expert systems.

This active learning book has been used by high school students; in both
undergraduate and graduate classes; in engineering, business, science
and education as well as in professional development workshops.