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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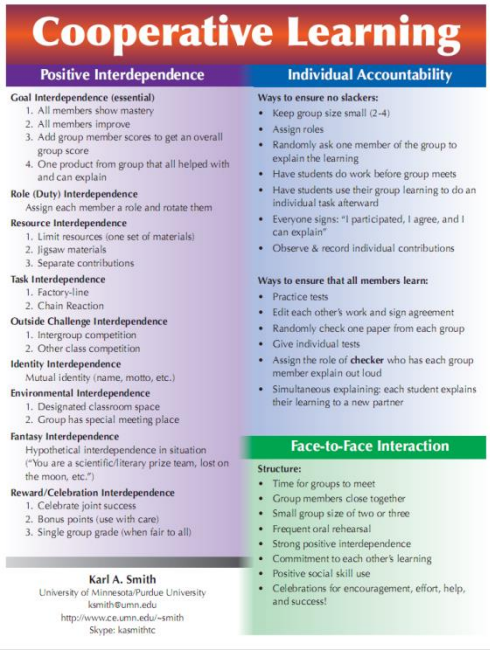
Estimation Exercise

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



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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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

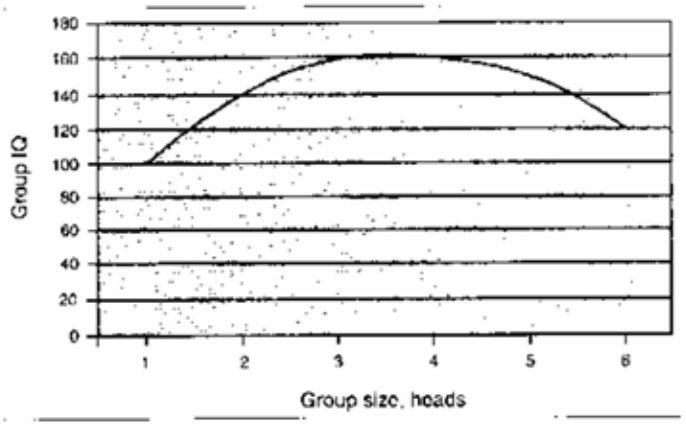
1. Specifying Objectives
2. Making Decisions
3. Explaining Task, Positive Interdependence, and Individual Accountability
4. Monitoring and Intervening to Teach Skills
5. Evaluating Students' Achievement and Group Effectiveness

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

Perkins, David. 2003. *King Arthur's Round Table: How collaborative conversations create smart organizations.* NY: Wiley.



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.

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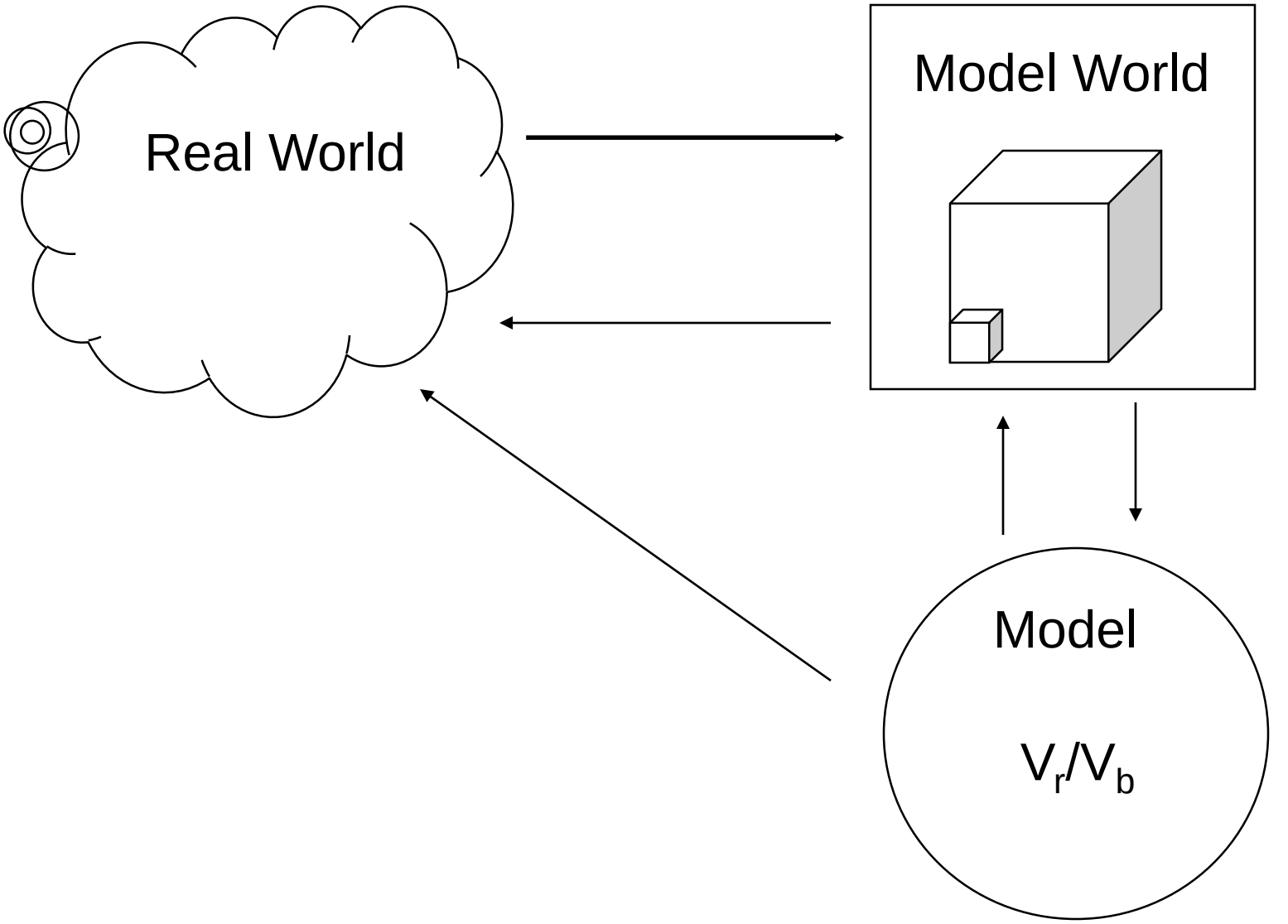
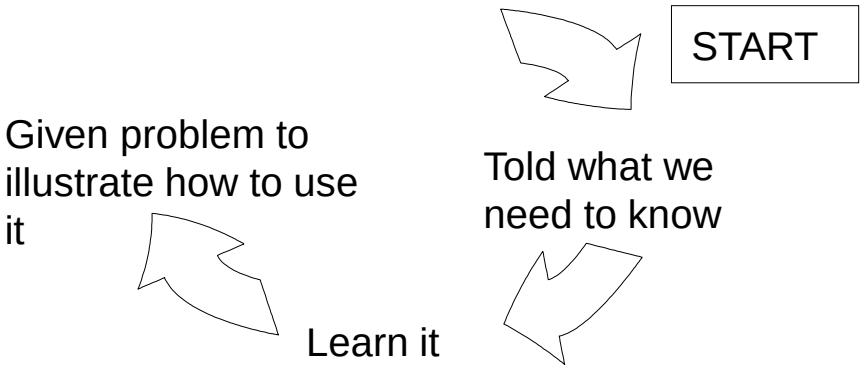
What Students Learn

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



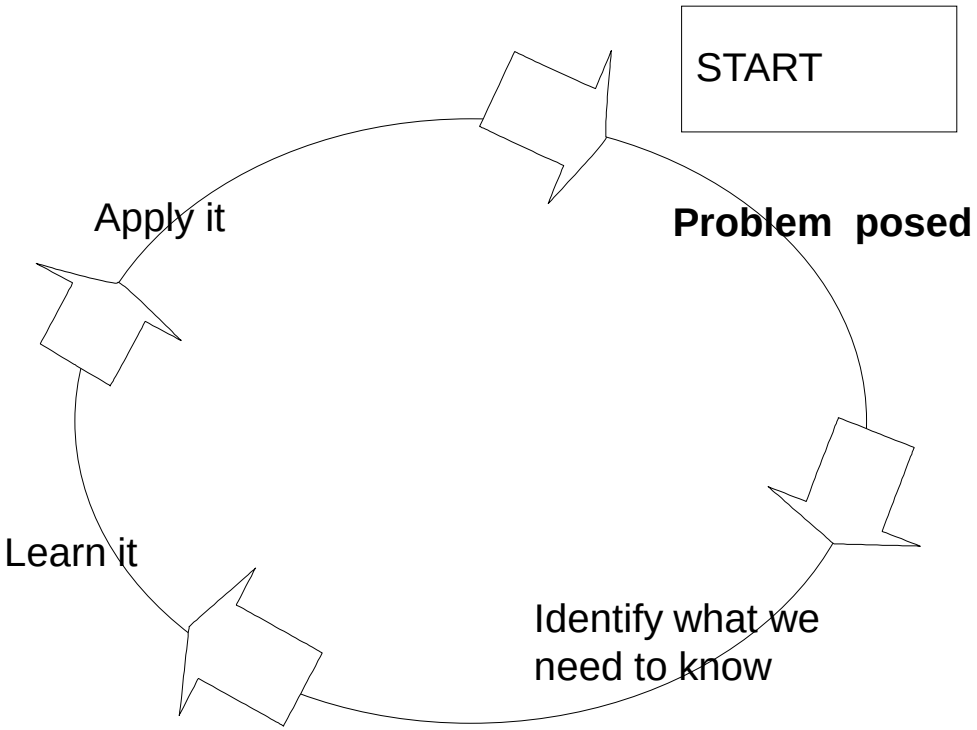
Typical Professional Curriculum:

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



Problem-Based Learning (PBL)

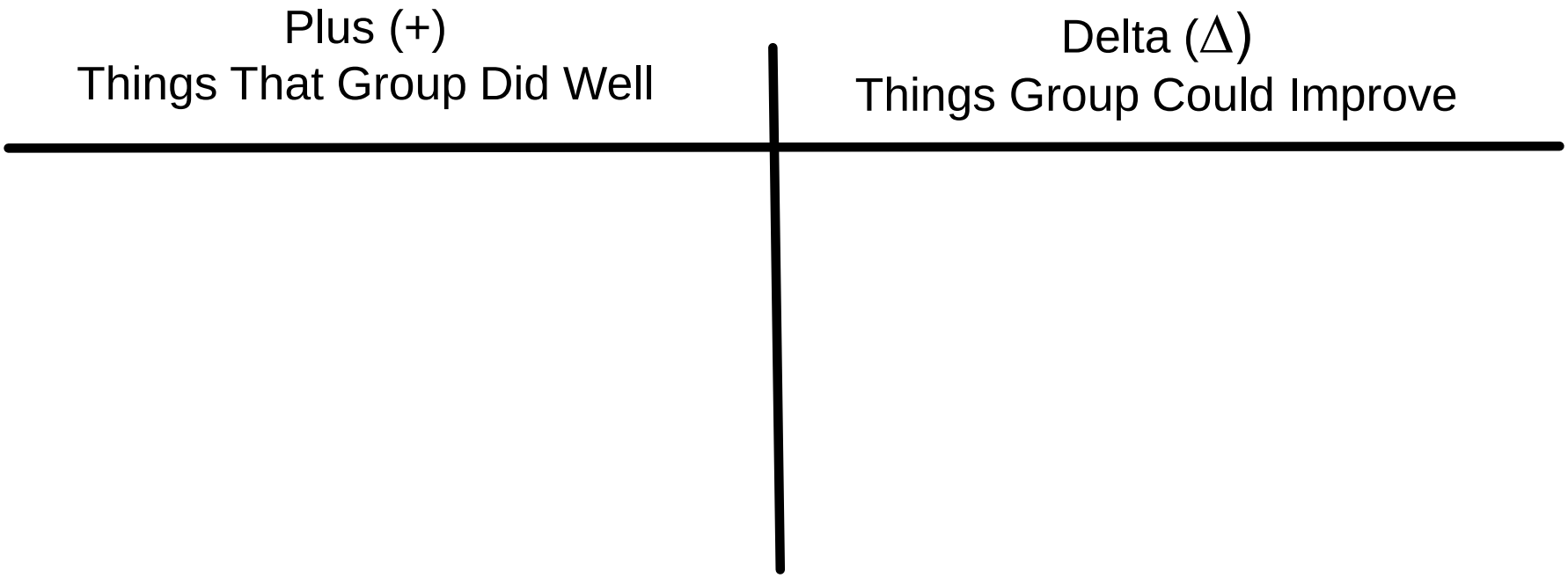
Problem-based learning is the learning that results from the process of working toward the understanding or resolution of a problem. The problem is encountered first in the learning process
- Barrows and Tamlyn, 1980

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



Action	Name 1	Name 2	Name 3	Name 4	Total
Contributes Ideas					
Describes Feelings					
Encourages Participation					
Summarizes, Integrates					
Checks for Understanding					
Relates New To Old Learning					
Gives Direction To Work					
Total