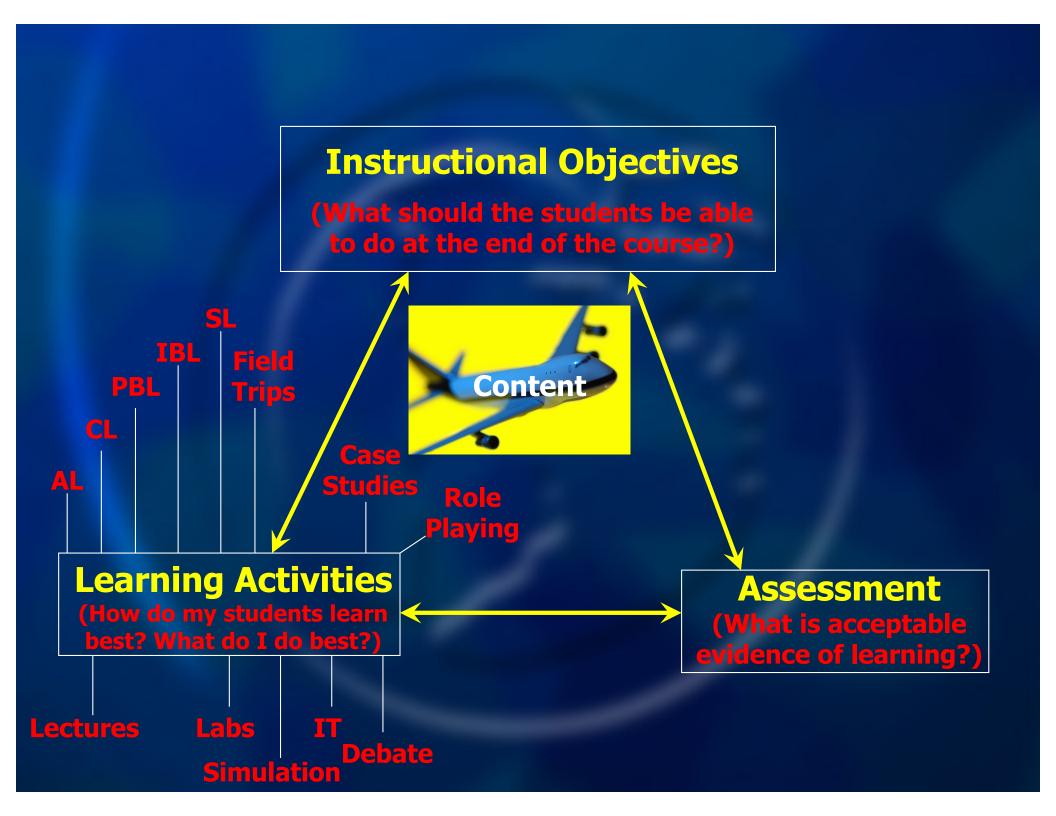# Engaging Students through Active, Cooperative, and Problem-Based Learning

Nikos J. Mourtos

Professor & Chair, Aerospace Engineering
San Jose State University

Session Objectives

- ❑ Experience AL, PBL, CL.
- ❑ Learn how to use CL effectively.
- ❑ Discuss the challenges in implementing CL.
- ❑ Assess the effectiveness of student teams.

Form teams of 4!
Get to know your teammates!

Team Leader

Responsibilities:

❑ Keep the process enjoyable and rewarding for all team members.

❑ Make sure each and every member participates and performs within their role.

❑ Guide the discussion and keep members on task.

❑ Manage time, stress, and conflict.

❑ Ensure that all members can articulate what has been learned.

❑ Contribute to the team and actively learn.

❑ Maintain accountability for the overall performance of the team.

Recorder

Responsibilities:

❑ Record instructions and each member's role at the beginning of a task.

❑ Document legibly and accurately team ideas, discoveries, answers and questions into a "Recorder's Journal".

❑ Integrate and synthesize when several ideas are presented.

❑ Control information flow, articulate concepts in alternative forms, if necessary.

❑ Contribute to the team and actively learn.

Spokesperson

Responsibilities:

❑ Speak for the team when called to do so.

❑ Ask questions posed by the team, or request clarification.

❑ Use the recorder's report to share the team's discoveries and insights.

❑ Collaborate with the recorder.

❑ Contribute to the group and actively learn.

Reflector

Responsibilities:

❑ Observe performance, interactions + dynamics among team members.

❑ Be a good listener + observer.

❑ Analyze + record team strengths, improvements needed, + insights into a "Reflector's Journal". Write evaluations positively + constructively.

❑ Intervene with observations about the process + suggest strategies for change.

❑ Contribute to the group and actively learn.

Assign roles within your team:

- ☐ **Captain:** person in team most familiar with fluid mechanics or the one who goes swimming more often.
- ☐ **Recorder:** person in team to the right of the captain.
- ☐ **Spokesperson:** person in team to the left of the captain.
- ☐ **Reflector:** the 4th person.

Introduce Problem

Reflection
Individually (2 min)

Write in your journals:

- [ ] The most interesting thing you learned from this problem.

- [ ] An outstanding question you still have.

Active Learning

All learning is active! The learner must always do something in order to learn (ex. read, think, write, solve problems, etc.).

❑ Old paradigm: the learner performs these activities after he / she leaves the classroom.

❑ New paradigm: AL implies that these activities are also performed in the classroom under the guidance of the teacher!

Sophocles

"One must learn
by doing the thing,
for though you think you know it,
you have no certainty,
until you try."

Wilbert J. McKeachie
"Teaching Tips:
Strategies, Research, and Theory for College & University Teachers"
10th ed., Houghton Mifflin, 1999, ch. 14.

The bottleneck in educational efficiency is that learning to think requires thinking and communicating the thinking through talking, writing, or doing, so that others can react to it.

PROBLEM-BASED LEARNING

❑ Students are first presented with a problem / case study.

❑ Then they work in teams to:

  ❖ Organize their ideas and previous knowledge related to the problem

  ❖ Pose questions on aspects of the problem they do not understand.

PROBLEM-BASED LEARNING
(cont'd)

❑ Lecturing follows but is kept to a minimum.

❑ Students are coached to search for information and work cooperatively to find answers.

❑ Faculty act more as coaches and facilitators, prompting with questions and providing guidance as necessary.

Why use PBL ?

❑ Topic-driven instruction is logical for someone who already understands the subject. It is not necessarily logical for someone who is trying to learn the subject.

❑ PBL keeps students engaged by using a problem as a point of focus.

Why use PBL ? (cont' d)

❑ Students take more responsibility for their learning (lifelong learning)

❑ Students become more receptive to theory discussed in class because they now have a purpose for all this (i.e., the problem at hand)

❑ Students learn how to formulate, define, and analyze problems (not the case when students follow solutions from example problems!)

Why use PBL ? (**cont'd**)

❑ Students acquire problem-solving skills and confidence in their technical competence, especially in situations where the problem is ill-defined and there is no single answer.

❑ Students develop communication and team skills.

COOPERATIVE LEARNING

Instruction which involves people working in teams to accomplish a common goal, under conditions that involve

1. positive interdependence
2. face-to-face promotive interaction
3. individual accountability
4. group accountability
5. group processing.

Johnson, D.W., Johnson, R.T., Smith, K. A.

Positive Interdependence

❑ All members must cooperate to complete the task.

❑ Team members swim together or sink together.

❑ Each team member must:

(a) do own part and

(b) teach own part to other members.

Positive Interdependence

To enforce:

❑ One set of answers from the group; everyone has to agree.

❑ Positive reward interdependence.

❑ Negative reward interdependence.

❑ Jigsaw puzzle.

❑ Quiz students about each other's parts.

Individual Accountability

❑ Each member is accountable for the complete final outcome (ex., everyone must be able to explain the strategies used to solve the problem).

❑ To enforce:

❖ small teams

❖ individual tests

❖ structure work like jigsaw puzzle

❖ personal note books

❖ call randomly on students to explain team's solution

Forming Teams:
Base vs. Informal

➢ Base or formal groups: formed in the beginning of the course to provide a comfortable, family-like environment for performing the various tasks.

➢ Informal groups: formed any time to practice working with others outside the base group and promote a strong feeling of cooperation across the entire class.

Forming Teams:
Large vs. Small

Large teams, pros:

➤ Larger range of:
- ❑ expertise
- ❑ abilities
- ❑ skills

within the group.

➤ Greater # of minds acquiring + processing information

➤ Greater # of hands available to do the various tasks

Forming Teams:
Large vs. Small (cont'd)

Cons: Large teams require advanced social skills to

➤ Provide everyone a chance to speak.

➤ Coordinate the actions of group members.

➤ Reach consensus.

➤ Ensure explanation and elaboration of the material being learned.

➤ Keep all members on task.

➤ Maintain good working relationships.

Lack of these skills will cause breakdown of the team process!!

Forming Teams:
Large vs. Small (cont'd)

Factors in deciding how many students per team:

➤ Time available : 2's work faster than 3's, etc.

➤ Student experience :

❑ experienced : can handle larger groups

❑ novice : need experience with small groups first

➤ Complexity of the task / Volume of work :

❑ simple task - small group

❑ complex task - larger group

Forming Teams: Heterogeneity

➤ Enhances elaborate thinking

➤ Increases frequency of giving & receiving of explanations

➤ Encourages perspective taking

➤ Enhances social skills

Teacher forms the teams. Mix :

❑ abilities

❑ sexes

❑ personalities

❑ ethnic groups

Face-to-Face Promotive Interaction

- ❑ Chemistry!
- ❑ Verbal interchange.
- ❑ Active participating.
- ❑ Mutual help and support.
- ❑ Encouraging.
- ❑ Explaining.
- ❑ Peer feedback.
- ❑ Increased productivity.
- ❑ Individual growth.

Interpersonal Skills

➢ Encouraging (participation)
➢ Checking (method, results, understanding)
➢ Elaborating

Ability to
➢ Function in a team.
➢ Reach consensus.
➢ Defend own opinion while being respectful of others.
➢ See things from the perspective of others.

Group Processing:
write down:

❑ 3 things your team did well while working together.

❑ 1 thing each member did, which helped the team.

❑ 1 thing your team needs to improve, to be more efficient next time.

3 min

Teacher as Facilitator

- ❑ *Guide on the side* rather than sage on the stage.
- ❑ Monitor groups. Make sure everyone is working and performing within their roles.
- ❑ Answer questions that cannot be answered within the groups.
- ❑ If a group seems to be going in the wrong direction, set them straight!
- ❑ Help with conflict resolution.

Why should we use CL?

Discuss in your team and come up with as many reasons as you can!

2 min

Why use CL ?
we retain:

➢ 10 % of what we read
➢ 20 % of what we hear
➢ 30 % of what we see
➢ 50 % of what we both see + hear
➢ 70% of what we discuss w. others
➢ 80% of what we experience personally
➢ 90% of what we say as we do something
➢ 95% of what we teach someone else

William Glasser
Stice, 1987
Dale's Cone of Learning, 1969

The exclusive use of lecture in the classroom constraints students' learning"

Why use CL ? (cont'd)

❑ People learn better when working with each other than when working in isolation or competing against each other.

❑ CL offers students multiple opportunities to practice team skills and small group communication skills, both of which are essential to succeed in the real world.

John D. Rockefeller

I will pay more for the ability to deal with people than any other ability under the sun."

Effects on Student Learning
(faculty perspective)

Prior to using CL, I was becoming more and more familiar with the subject

but the majority of the students were not. Now we all are.

Chemical Engineering professor

Why use CL ? (cont'd)

❑ Less stress / anxiety than competitive mode of teaching.

❑ Frequent feedback by instructor and peers.

Why use CL?

❑ Increases faculty instructional productivity. (Johnson D.W., Johnson R.T., Smith K.A.)

❑ Promotes higher order thinking skills. (Johnson D.W., Johnson R.T.)

❑ Improves student retention. (Tinto, V.)

(Astin, A.)

What are some of the challenges in implementing CL?

Discuss in your team and come up with as many challenges as you can!

2 min

Challenges with CL

❑ Competitiveness inherent in some fields.

❑ Commuter campus / lack of community.

❑ Free riders / unprepared students.

❑ Airline cabin syndrome (classroom arrangement).

How can we overcome these challenges ?

Discuss in your team and come up with as many ways as you can!

2 min

Reflection on the workshop

❑ The most interesting thing you're taking away.

❑ One thing you're ready to try.

❑ Unanswered questions ?

2 min