Designing and Facilitating Effective Collaborative Learning Activities

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## Competing Paradigms of Education

<table>
<thead>
<tr>
<th>Teaching-Centered</th>
<th>Learning-Centered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher is “sage on the stage,” lecturing to a class of passive note-taking students</td>
<td>Teacher is “guide on the side:” Students are actively engaged, often working in small groups</td>
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</tbody>
</table>
## Assumptions About Education*

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<tr>
<td>• Content is primary and instructor owns the knowledge</td>
<td>• Process of learning is as important as the content learned.</td>
</tr>
<tr>
<td>• Instructor is central</td>
<td>• Instructor and students are partners</td>
</tr>
<tr>
<td>• Success is an individual accomplishment</td>
<td>• Success results from teamwork</td>
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</table>

These assumptions are debatable.

*McManis (2005) Leaving the Lectern*
Assumptions About Education*

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<tr>
<td>• Students differ little from instructor</td>
<td>• Many students differ from instructor</td>
</tr>
<tr>
<td>• Students enter class with empty minds</td>
<td>• Students enter class with a perceptual framework intact</td>
</tr>
<tr>
<td>• Learning is cumulative</td>
<td>• Learning is a dynamic process of restructuring.</td>
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The learning-centered assumptions are more in line with reality.

*McManis (2005) Leaving the Lectern*
# Educational Goals

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<tr>
<td>• Instructor transfers information to students</td>
<td>• Instructor creates a learning environment</td>
</tr>
<tr>
<td>• Students accumulate knowledge</td>
<td>• Students develop skills in constructing and using knowledge</td>
</tr>
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*McManis (2005) *Leaving the Lectern*
Research on Collaborative Learning


Research on Collaborative Learning

Meta-analysis of 39 studies of collaborative learning in post-secondary STEM courses.

\[ d = \frac{\text{mean}_1 - \text{mean}_2}{\sqrt{(SD_1^2 - SD_2^2) / 2}} \]

\( d \) = effect size

SD = standard deviation

A \( d \) of 0.5 is considered a medium effect size.

Collaborative Learning Structure: Think-Pair-Share

• Reflect on your experience with teaching-centered and learning-centered classes.
  - What worked for you? Why?
  - What didn’t work for you? Why not?

• Pair up: discuss your answers.
Examples of Effective Collaborative Learning Structures

- Think-Pair-Share
- Peer Teaching (using clickers)
- Guided-Discovery Labs
- Interteaching
- Jigsaw
Peer Instruction

- Lectures are interspersed with conceptual multiple-choice questions (**ConcepTests**), designed to expose common difficulties in understanding the material.
  - Students answer the question, using clickers (1-2 minutes).
  - Instructor displays the distribution of answers.
  - Students discuss their answers in small groups (2-3 minutes).
  - Students answer the question again.

http://mazur-www.harvard.edu/
Effectiveness of Peer Instruction

FCI = Force Concept Inventory
Where is **addition of water** an important cause of mantle melting?

A. Subduction zones.

B. Sea-floor spreading ridges.

C. Rising mantle plumes (hot spots).

D. All of the above.

E. None of the above.
How clickers work

• Students buy the clickers ($30-60)
• You get the software and receiver free

http://www.h-itt.com/

http://www.iclicker.com/
Effectiveness of Peer Instruction in Introductory Geology
(unpublished CSU Chico Data from Fall 2007)

Normalized Gain on the Geoscience Concept Inventory

Normalized Gain = \frac{\text{PostCourse Score} - \text{PreCourse Score}}{100\% - \text{PreCourse Score}}
The most difficult part of peer instruction is coming up with good conceptual questions.

For ideas, go to serc.carleton.edu and search for “conceptests.”
Guided-Discovery Lab Activities

- Lab on a topic precedes lecture on it.
- Questions about hands-on activities lead students toward discovery of important concepts.
- Groups present their discoveries to the rest of the class
In a room lit by only one light bulb, hold a polystyrene ball on a pencil as shown.

Slowly rotate your body, keeping the “moon” in front of you and watching as various parts of the white ball become lit and/or shaded.
Complete the diagram, showing how the moon looks from Earth in various locations on its orbit.
Interteaching*

• Instructor writes a prep-guide: questions designed to guide students through a reading assignment.

• Students write notes on the reading with pre-guide questions in mind.

• In class, students work in groups of 2-3 to compose answers to questions.

• Instructor bases next lecture on problems students had with questions.

Effectiveness of Interteaching

The Jigsaw Structure*

1. Design an assignment with multiple related but independent aspects, one for each group member.

The Jigsaw Structure*

Groups

Example:

- Variations in time of moon rise and set.
- Tilt of lit part of moon relative to horizon.
- Maximum altitude of moon vs. phase and season.
- Maximum altitude of moon vs. astronomical place.

The Jigsaw Structure*

2. Students responsible for the same aspect of the project join together and form teams.

Teams work to

- Master the concepts in their aspect of the project.
- Develop ways to teach their aspect to their groups.

The Jigsaw Structure*

Groups

3. Groups reunite; each member teaches his/her aspect of the project to the rest of the group.

Give Collaborative Learning a try!