Active Learning: Introducing Students to Communities of Practice

Columbia Center for New Media Teaching & Learning

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Workshop Goal:
Faculty who understand and can design effective Active Learning exercises.
Crying Out Loud

What are your problems?
What are your experiences?
What are your expectations?
Questions to answer

Effective *Active Learning* exercises?

- What kind of learning / knowing is the goal?
  - An epistemology

- How can one know what a student knows?
  - Case for assessment and feedback

- How can technology make a difference?
  - Adding capabilities for effective *active learning*
Overview

Cases for study - It looks like this ...
  • What they are after?

Essential ingredients
  + information technology

Designing your own
  • connecting to CCMTL
Case 1

Concept building and reasoning

[Clip of Nick Turro's class's discussions of a concept question]

How many distinct molecules can you conceive of using this combination of atoms $\text{[C}_5\text{H}_{12}]$?

[Clip of Eric Mazur's conduct of a concept question discussion]

Which statement can you conclude is true about the (possible) electrical charges on three objects based upon the following observations of their interactions with one another?
Case 2

Learning to formulate and recognize representations
Abstract symbols gain meaning if linked to picture-like and diagrammatic descriptions.

陆地上有轮子的交通工具
Case 2 (cont.)

Learning to formulate and recognize representations
Moving among multiple representations.

Determine the normal force that a 10-m radius hump in the road exerts on the 40-kg cart traveling at 8 m/s.

\[(40 \text{ kg})(9.8 \text{ m/s}^2) - N = (40 \text{ kg}) \left[\frac{(8 \text{ m/s})^2}{10 \text{ m}}\right]\]
Case 3

Developing higher-order learning - solving complex problems

What do we need to do to launch the spring from the end of this rod into the box across the room.

Indicate any assumptions you make and justify them.
Case 3 (cont.)

Developing higher-order learning - solving complex problems

What genre of fiction does the following plot line and sample passage suggest?

Indicate any assumptions you make and justify them.
Taxonomy of our Active Learning Process

1. Building concepts and reasoning

2. Learning to represent and recognize with understanding using multiple representations; changing representations in any direction

3. Developing high-order thinking skills
Aspects of our Active Learning Process

- Students must participate *actively* to make sense of symbols, concepts, relations ...
- Students can *test* their understanding and get (immediate) *feedback*
- (In-class) exercises should be short ... 5-10 mins.
- Activities should address -- teamwork, communication skills, learn to learn, *etc.*
- Exercises can be extended out-of-class via *IT*!
Active Learning Helps

I. FORCE CONCEPT INVENTORY (Concepts)

% GAIN vs % PRETEST SCORE

- 100% Average Posttest Score
- 93% Average Posttest Score ("Mastery")
- 60% Average Posttest Score ("Threshold")

Interactive Engagement

Traditional

% Gain = (% Posttest - %Pretest) / %Pretest

g = slope = Gain / (Max. Possible Gain)

% Pretest

HS  UNIV.
1. What kind of learning/knowing is the goal?  
   An epistemology

2. How can one discover what a student knows?  
   Case for assessment and feedback

3. How can technology make a difference?  
   Adding capabilities for effective active learning
Question 1: What kind of learning is the goal?

An Epistemology:

Every instructional design assumes one.

Data: values connected to direct experience

Information: data with interpretive structure

Knowledge: information with abstractive generalization

Each stage is constructed from the previous one and built into a complex, inter-related structure.
**Distinctions:** *Data, Information, Knowledge*

**Data** counting Internet host sites.

**Information** showing a pattern.

<table>
<thead>
<tr>
<th>Report date</th>
<th>No. of sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr - 92</td>
<td>890,000</td>
</tr>
<tr>
<td>Apr - 93</td>
<td>1,485,000</td>
</tr>
<tr>
<td>Jan - 92</td>
<td>727,000</td>
</tr>
<tr>
<td>Jan - 93</td>
<td>1,313,000</td>
</tr>
<tr>
<td>Jan - 94</td>
<td>2,217,000</td>
</tr>
<tr>
<td>Jan - 95</td>
<td>4,900,000</td>
</tr>
<tr>
<td>Jan - 96</td>
<td>9,700,000</td>
</tr>
<tr>
<td>Jan - 97</td>
<td>16,000,000</td>
</tr>
<tr>
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<td>992,000</td>
</tr>
<tr>
<td>Jul - 93</td>
<td>1,775,000</td>
</tr>
<tr>
<td>Jul - 94</td>
<td>3,100,000</td>
</tr>
<tr>
<td>Jul - 95</td>
<td>7,000,000</td>
</tr>
<tr>
<td>Jul - 96</td>
<td>12,600,000</td>
</tr>
<tr>
<td>Oct - 92</td>
<td>1,135,000</td>
</tr>
<tr>
<td>Oct - 93</td>
<td>2,056,000</td>
</tr>
</tbody>
</table>
Knowledge construct:

Roles for this graph?
– deeper insights about mathematical relation
– recognition that this is one of characteristic type
– provision of predictive criteria for testing
**Distinctions: Data, Information, Knowledge**

**From the previous example:**

<table>
<thead>
<tr>
<th>Data</th>
<th>Information</th>
<th>Knowledge</th>
</tr>
</thead>
</table>
| No. of Internet hosts at various survey dates | Multiple representations:  
  • Table  
  • Graph  
  • Equation | Growth rate is independent of time  
Exponential function whose exponent is this graph's slope  
First order differential equation |
Question 2: **What is currently learned?**

**Assessment and Evaluation:**

**Modes of knowing**

Has the student come to know as **data**?
*Ask for a literal answer.*

Has the student come to know as **information**?
*Ask for a relationship.*

Has the student come to know as **knowledge**?
*Ask for an application of principle beyond the context of its invention.*
Assessment, collaboration, reflection: Modes of interacting

In the Learning Cycle:

- The *living* syllabus - objectives, assignments, feedback
- Many *uses* of assessment - pre-, in-, post-lecture questions
- Student *collaborations* - reflective, moderated electronic discussions

In the Instructional Design Cycle:

- *Classroom research* - setting goals and hypotheses
- *Iterative* IT development - dialogue with media designers
Designing Assessments

1. Set context - scope, target, and cycle time
2. Set objectives and criteria
3. Use multiple instruments
4. Evaluate the results
5. Use of results - feedback to students
Instruments of Active Learning Assessment

1. Concept Tests
2. Sixty second essay
3. What's the principle?
4. Student-generated test questions
5. Muddiest point via e-mail feedback
Activity design and Classroom research

Principles of instructional design:

• Make a prototype exercise
• Use multiple design and testing cycles
• Assess exercise effectiveness
• Evaluate and refine the exercise
• Include students in the process
CCNMTL can help ...

Individual attention from professionals for your priorities in specific courses

- Web-sites as resources for active learning
- Electronic bulletin boards for out-of-class discussions and feedback
- Assessment design, rubrics, evaluation