Interactive teaching:
Turning a large lecture into a seminar

Stipendiatentreffen der Daimler-Benz-Stiftung
Ladenburg, 16. September 2006
shift focus from “teaching” to helping students learn
Outline

• Education
Outline

• Education

• Peer Instruction
Outline

• Education
• Peer Instruction
• Results
Education
Education

lectures focus on delivery of information
education is not just information transfer
Education

education is not just information transfer

![Bar chart showing the FCI posttest scores for 1990.](image)
education is not just information transfer
change in score, $S_f - S_i$ (%) vs initial score, $S_i$ (%) for the year 1990 combined.
The diagram illustrates the change in score, $S_f - S_i$, in relation to the initial score, $S_i$, as a percentage. The perfect score is represented by a point on the graph.

The line in the graph suggests a direct relationship between the initial score and the change in score, with higher initial scores leading to smaller changes in score. This relationship can be described by the equation $S_f - S_i = -kS_i$, where $k$ is a constant.
only one quarter of maximum gain realized

\[ g = \frac{S_f - S_i}{1 - S_i} \]

Education

not transfer but assimilation of information is key
conventional problems misleading
conventional problems misleading

Calculate:

(a) current in 2- resistor or

(b) potential difference
   between P and Q
are the basic principles understood?
are the basic principles understood?

When S is closed, what happens to:

(a) intensities of A and B?
(b) intensity of C?
(c) current through battery?
(d) potential difference across A, B, and C?
(e) the total power dissipated?
Education

conventional

conceptual
**Education**

**conventional**

![Bar chart for conventional method]

- Average score: 6.9

**conceptual**

![Bar chart for conceptual method]

- Average score: 4.9
Education

![Graph showing a comparison between conceptual and conventional problems.](image-url)
So what should we do?
Give students more responsibility for gathering information...
Give students more responsibility for gathering information... so we can better help them assimilate it.
1. Recognize the inefficacy of the lecture method
1. Recognize the inefficacy of the lecture method
2. Move first exposure to material out of classroom
Peer Instruction

2. Move first exposure to material out of classroom

...assign reading!
Peer Instruction

3. Use class period to deepen and broaden understanding
Peer Instruction

...by painting the big picture...
Peer Instruction

...and giving your students time to think and discuss
Better yet: Learn from your students…
Peer Instruction

Better yet: Learn from your students...
Better yet: Learn from your students…
Peer Instruction

...bring in your Teaching Assistants too!
Peer Instruction

Main features:

• pre-class reading

• in-class: depth, not ‘coverage’

• ConcepTests
Peer Instruction

ConcepTest:

1. Question
2. Thinking
3. Individual answer
4. Peer discussion
5. Revised/Group answer
6. Explanation
Let’s try it!

Consider a rectangular metal plate with a circular hole in it.
Let’s try it!

Consider a rectangular metal plate with a circular hole in it.

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.
Let’s try it!

It’s easy to fire up the audience!
Let’s try it!

The distance between the atoms increases uniformly
Research: providing the basis for change

ConcepTest data

before discussion

<table>
<thead>
<tr>
<th>answer</th>
<th>count</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>40</td>
</tr>
<tr>
<td>B</td>
<td>80</td>
</tr>
<tr>
<td>C</td>
<td>40</td>
</tr>
</tbody>
</table>

just guessing
not quite sure
pretty sure
Research: providing the basis for change

ConcepTest data

after discussion

<table>
<thead>
<tr>
<th>answer</th>
<th>count</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>160</td>
</tr>
<tr>
<td>C</td>
<td>80</td>
</tr>
</tbody>
</table>

- pretty sure: 160
- not quite sure: 80
- just guessing: 40

just guessing
Feedback methods

Show of hands:

easy, but only moderately effective
Feedback methods

Flashcards: simple and effective
Feedback methods

Flashcards: simple and effective

Meltzer and Mannivanan, South Eastern Louisiana University
Feedback methods

Infrared transmitters (PRS): easy collection of data
Feedback methods

Infrared transmitters (PRS): easy collection of data

Kristy Beauvais, Concord Carlisle High School
Feedback methods

near future: wireless classroom
is it any good?
Results

First year of implementing PI

1991 FCI pretest

Count

Score

0 5 10 15 20 25
Results

first year of implementing PI

1991 FCI posttest

![Bar chart showing distribution of scores](chart.png)
Results

first year of implementing PI

1991 combined

count

score

0 5 10 15 20 25
Results

change in score, $S_f - S_i$ (%)

initial score, $S_i$ (%)

$g = \frac{S_f - S_i}{1 - S_i}$

perfect score

0.23

1.00
Results

The diagram illustrates the change in score, $S_f - S_i$, as a function of the initial score, $S_i$. The equation $g = \frac{S_f - S_i}{1 - S_i}$ is shown, where $g$ represents the change in score. The graph shows a perfect score line and data points that follow the given equation.
Results

\[ g = \frac{S_f - S_i}{1 - S_i} \]

Results

\[ g = \frac{S_f - S_i}{1 - S_i} \]

what about problem solving?
1985 exam scores
Results

1991 exam scores

![Histogram showing exam scores](image)
Results

1985/91 exam scores

<table>
<thead>
<tr>
<th>Exam Score (%)</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 20</td>
<td></td>
</tr>
<tr>
<td>20 - 40</td>
<td></td>
</tr>
<tr>
<td>40 - 60</td>
<td></td>
</tr>
<tr>
<td>60 - 80</td>
<td></td>
</tr>
<tr>
<td>80 - 100</td>
<td></td>
</tr>
</tbody>
</table>

Exam scores
So better understanding leads to better problem solving!
So better understanding leads to better problem solving!

(but “good” problem solving doesn’t always indicate understanding!)
Why does it work?

Students:

• promotes thinking
• helps uncover and address misunderstanding
• boosts confidence
Why does it work?

Students:
- promotes thinking
- helps uncover and address misunderstanding
- boosts confidence

Faculty:
- change of format, not content
- with existing questions, little effort
- adaptable
A little reorganization goes a long way!
Funding:

National Science Foundation

for a copy of this presentation:

http://mazur-www.harvard.edu