Confessions of a converted lecturer

Distinguished Lecture on Teaching and Learning
National Taiwan University
Taipei, Taiwan, 31 May 2010
shift focus from “teaching” to helping students learn
Outline

• Education
Outline

• Education

• Peer Instruction
Outline

• Education

• Peer Instruction

• Results
lectures focus on delivery of information
education is not just information transfer

![Bar chart showing 1990 FCI pretest scores](image)
education is not just information transfer

1990
FCI posttest

count

score
education is not just information transfer
change in score, $S_f - S_i$ (%) vs. initial score, $S_i$ (%)
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
Calculate:

(a) current in 2-Ω resistor

(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?
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.
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
is it any good?
Results

first year of implementing PI

1991 FCI pretest

score

count

0 5 10 15 20 25

25

20

15

10

5

0

0 5 10 15 20 25
Results

first year of implementing PI

1991 FCl posttest
Results

first year of implementing PI

![Bar chart showing data for 1991 combined]
Results

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

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

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

Results

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

what about problem solving?
Results

1985 exam scores
Results

1991 exam scores

- Exam scores (%)
- Count

Bar chart showing the distribution of exam scores for the year 1991.
Results

1985/91 exam scores

exam score (%)

count

0 20 40 60 80 100

25 20 15 10 5 0

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!)
Traditional indicators of success misleading
Traditional indicators of success misleading

Education is no longer about information
Funding:

National Science Foundation

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brief presentation
Peer Instruction: a primer

brief presentation

ConcepTest
Peer Instruction: a primer

- brief presentation
  - ConcepTest
    - clicker poll 1
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

> 70% correct
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

> 70% correct

explanation
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

> 70% correct

explanation

repeat from start
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

30–70% correct

> 70% correct

explanation

repeat from start
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

30–70% correct

peer discussion

> 70% correct

explanation

repeat from start
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

30–70% correct

peer discussion

clicker poll 2

> 70% correct

explanation

repeat from start
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

< 30% correct

peer discussion

clicker poll 2

30–70% correct

explanation

> 70% correct

repeat from start
Peer Instruction: a primer

brief lecture

ConcepTest

clicker poll 1

< 30 % correct

revisit concept

30–70% correct

peer discussion

clicker poll 2

> 70% correct

explanation

repeat from start
Peer Instruction: a primer

- Brief presentation
- ConcepTest
- Clicker poll 1
  - < 30% correct: revisit concept
  - 30–70% correct: peer discussion
  - > 70% correct: explanation
- Clicker poll 2
- Repeat from start
Let’s try it!

When metals heat up, they expand because all atoms get farther away from each other.
Let’s try it!

When metals heat up, they expand because all atoms get farther away from each other.
Let's try it!

Consider a rectangular metal plate with a circular hole in 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.
It’s easy to fire up the audience!
remember: all atoms must get farther away from each other!
Let’s try it!

remember: all atoms must get farther away from each other!
Let’s try it!

consider the atoms at the rim of the hole
Let’s try it!

consider the atoms at the rim of the hole
Let’s try it!

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Let’s try it!

consider the atoms at the rim of the hole
What constitutes a good problem?
Setting the stage

On a Saturday afternoon, you pull into a parking lot with unme-tered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.
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How long do you have to wait before someone frees up a space?
On a Saturday afternoon, you pull into a parking lot with unme-tered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?

Requires:

Assumptions
Developing a model
Applying that model
On a Saturday afternoon, you pull into a parking lot with unme-tered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces. **On average people shop for 2 hours.**

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Assuming people leave at regularly-spaced intervals, how long do you have to wait before someone frees up a space?
On a Saturday afternoon, you pull into a parking lot with unme-tered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces. On average, people shop for 2 hours.

**Assuming people leave at regularly-spaced intervals, how long do you have to wait before someone frees up a space?**

**Requires:**

Applying a (new) model
On a Saturday afternoon, you pull into a parking lot with unme-tered spaces near a shopping area, where people are known to shop, on average, for 2 hours. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?
On a Saturday afternoon, you pull into a parking lot with unmeasured spaces near a shopping area, where people are known to shop, on average, for 2 hours. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?

\[ t_{\text{wait}} = \frac{T_{\text{shop}}}{N_{\text{spaces}}} \]
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How long do you have to wait before someone frees up a space?

Requires:

Using a calculator

\[ t_{\text{wait}} = \frac{T_{\text{shop}}}{N_{\text{spaces}}} \]
Need to test meaningful skills!
Setting the stage

Setting learning goals
Setting the stage

Setting learning goals

• approach, not content
• focus on understanding
• backward design
Setting the stage

Traditional approach to course planning
Setting the stage

Traditional approach to course planning
Setting the stage

Traditional approach to course planning

Course defined by content

Course content → Assessment
Setting the stage

Backward design

desired outcomes
Setting the stage

Backward design

acceptable evidence → desired outcomes
Backward design

- instructional approach
- acceptable evidence
- desired outcomes
Setting the stage

Backward design

- instructional approach
- acceptable evidence
- desired outcomes

course defined by desired outcomes
A boat carrying a large boulder is floating on a small pond. The boulder is thrown overboard and sinks to the bottom of the pond.
A boat carrying a large boulder is floating on a small pond. The boulder is thrown overboard and sinks to the bottom of the pond.

After the boulder sinks to the bottom of the pond, the level of the water in the pond is

1. higher than  
2. the same as  
3. lower than

it was when the boulder was in the boat.
Let’s try it!

We all make mistakes!
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