Introduction
Introduction

lectures focus on transfer of information
Introduction

instructor: busy delivering information
Introduction

instructor: busy delivering information

students: busy taking notes
Introduction

instructor: no time for individual help

students: no time to think
not transfer but assimilation of information is key
Outline

• Peer Instruction

• PI at Concord-Carlisle High School

• PI at Marblehead High School
Peer Instruction

Force Concept Inventory

Use the statement and figure below to answer the next two questions (15 and 16).

A large truck breaks down on the road and receives a push back into town by a small compact car as shown in the figure below.

15. While the car is still pushing the truck, it is speeding up to get up to cruising speed.
   ___ 1. the amount of force with which the car pushes on the truck is equal to that with which the truck pushes back on the car.
   ___ 2. the amount of force with which the car pushes on the truck is smaller than that with which the truck pushes back on the car.
   ___ 3. the amount of force with which the car pushes on the truck is greater than that with which the truck pushes back on the car.
   ___ 4. the car's engine is running so the car pushes against the truck but the truck's engine is not running so the truck cannot push back against the car. The truck is pushed forward simply because it is in the way of the car.
   ___ 5. neither the car nor the truck exerts any force on the other. The truck is pushed forward simply because it is in the way of the car.

16. After the car reaches the constant cruising speed at which its driver wishes to push the truck.
   ___ 1. the amount of force with which the car pushes on the truck is equal to that with which the truck pushes back on the car.
   ___ 2. the amount of force with which the car pushes on the truck is smaller than that with which the truck pushes back on the car.
   ___ 3. the amount of force with which the car pushes on the truck is greater than that with which the truck pushes back on the car.
   ___ 4. the car's engine is running so the car pushes against the truck but the truck's engine is not running so the truck cannot push back against the car. The truck is pushed forward simply because it is in the way of the car.
   ___ 5. neither the car nor the truck exerts any force on the other. The truck is pushed forward simply because it is in the way of the car.
education is not just information transfer
Peer Instruction

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Peer Instruction

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Peer Instruction

![Graph showing change in score, $S_f - S_i$ (%) versus initial score, $S_i$ (%). The graph includes a comparative inset labeled 1990 combined.](image)
Peer Instruction

![Graph showing the change in score, $S_f - S_i$, as a function of the initial score, $S_i$.]
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only one quarter of maximum gain realized

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

what causes this problem?
Peer Instruction

conventional problems reinforce bad study habits
conventional problems reinforce bad study habits

Calculate:
(a) current in 2-Ω resistor
(b) potential difference between P and Q
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are the basic principles understood?
Peer Instruction

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?
Peer Instruction

conventional

conceptual

![Bar charts comparing conventional and conceptual approaches with score on the x-axis and count on the y-axis.](image)
Peer Instruction

conventional

conceptual

average 6.9

average 4.9
Peer Instruction

![Graph showing the comparison between conceptual and conventional problem solutions.](chart.png)
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?
Peer Instruction

let’s try it!
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.
Peer Instruction

first year of implementing PI

1991 FCI pretest
Peer Instruction

first year of implementing PI

1991 FCI posttest
Peer Instruction

first year of implementing PI

1991 combined

count

score

0 5 10 15 20 25

0 5 10 15 20 25
Peer Instruction

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

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

Initial score, $S_i$ (%)
Peer Instruction

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

initial score, \( S_i \) (\%)

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

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

Peer Instruction

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

what about problem solving?
Peer Instruction

1985 exam scores

Exam scores (%)

Count

0 20 40 60 80 100
Peer Instruction

1991 exam scores

Exam score (%)

Count
Peer Instruction

1985/91 exam scores

Exam score (%)

Count
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!)
Outline

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• PI at Marblehead High School
What you need to know up front:
What you need to know up front:

• the kids love it!
What you need to know up front:

- the kids love it!
- it’s easy to use
What you need to know up front:

- the kids love it!
- it’s easy to use
- it really works
But…
But…

- it takes time
But...

- it takes time

- it might not work every time
But...

- it takes time
- it might not work every time
- it requires assessment
Methods of implementation:

- heads down, hands up
- index cards
- Personal Response System
Strategies for success:

- explain pedagogy
Strategies for success:

- explain pedagogy
- maximize opportunities for success
make sure enough are initially correct!

% correct answers

before discussion

after discussion

% correct answers

0 20 40 60 80 100

0 20 40 60 80 100
make sure enough are initially correct!
make sure enough are initially correct!

![Graph showing the percentage of correct answers before and after discussion.](image-url)
optimum range: 35–70% correct initially

PI at Concord-Carlisle HS
Strategies for success:

• explain pedagogy

• maximize opportunities for success
Strategies for success:

• explain pedagogy

• maximize opportunities for success

• explain results
How to get started tomorrow:

• prepare 3–4 sentence handout

• find questions (online or in book)

• find 10–15 minutes

• try it!
Outline

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- PI at Marblehead High School
PI used at three levels:

- Advanced Placement physics
- Honors Weighted physics
- College Preparatory I physics
Results:

• improvement on FCI over first term of instruction

• students asking more and better questions
Low-budget implementation:

- manila packing tags strung loosely in packs of 5
- tags numbered 1–5
- each number different color
Personal Response System:

- still in implementation phase
- students fascinated by receiver on the wall
- students excited about the “remote control thingies”
- creation of question and answer files easy
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Finding time to implement... another story!
Some take-home points:

• it works at all levels
• it doesn’t require technology
• it doesn’t require much effort
• you can do it — tomorrow!
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