Peer Instruction: Methods and Techniques

Suvendra Nath Dutta
IT Fellow, Mazur Group & DEAS IT Group
Division of Engineering & Applied Sciences
Harvard University

University of New Hampshire
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Outline

Problem
- Teaching focused towards top 1%
- Focused on memorization not understanding

Cause
- Lectures focused on fact transmission
- Traditional problems reinforce poor learning

Solution
- Interactive learning
In physics only 1% take more than their first physics course

Looking at research common problems emerge:
- Frustration
- Lack of basic knowledge
- Lack of understanding

But biggest problem of all:
- They don’t care!
Why do we have this problem?

- Lectures focus on transfer of information
- Conventional questions reinforce poor studying habits

Q: Calculate current through the 2 Ω resistance ...
Why do we have this problem

- Results of standardized test focusing on concepts rather than problems

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Why do we have this problem

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What is the solution?

- **Give students a reason to care**
  - Take fact transmission out of classroom
    - Reading assignments! Reading assignments! Reading assignments!
  - Make lectures more responsive
    - Focus lectures on student’s misunderstandings.
    - Uncover rather than cover
  - Make lectures more interactive
    - Make sure students are following teaching
- **Give students a more active role**
  - Give them the opportunity to get the ah-hah feeling
Interaction outside class: JiTT

- Assign reading
  - Insist student read **before** class.
  - Test them on reading, **not** on understanding
  - Ask the special question:
    “What did you find confusing about the reading? If you found nothing confusing mention something that you found interesting.”

- Make it worthwhile for them
  - Give them grades for trying (not for correctness)
  - Read the responses to JiTT question
  - Respond directly or address question in lecture

Ref: **Just-In-Time Teaching**: Blending Active Learning With Web Technology (Prentice Hall Series in Educational Innovation) by Gregor M. Novak (Editor), Evelyn T. Patterson, Andrew D. Gavrin
http://webphysics.iupui.edu/jitt/jitt.html
Interaction in class: PI

- After discussing a significant concept:
  - Stop; ask ConcepTest question
  - Steps:
    1. Question
    2. Thinking
    3. Individual answer
    4. Peer discussion
    5. Individual answer
    6. Instructor explanation
  - Adjust lecture based on feedback
Does it work?

The standardized test in a class using PI

1991
FCI pretest

count

0 5 10 15 20 25
score
Does it work?

The standardized test in a class using PI
Does it work?

The standardized test in a class using PI
Does it work?

The standardized test in a class using PI
Does it work?

The standardized test in a class using PI
Consider a rectangular plate with a circular hole in it.

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

1. Increases
2. Decreases
3. Stays the same
A boat carrying a large boulder is floating in a lake. The boulder is thrown overboard and sinks to the bottom of the lake.

Does the level of the water in the lake (with respect to the shore):

1. go up
2. go down, or
3. stay the same?
ConcepTest Design Messages

- Focus on a concept not fact.
- Make them think not remember
- Incorrect answers in a multiple choice are important
  - Ask open ended question first
  - Make most common incorrect answer the “distracter” incorrect responses.
- Try to measure the gain* of a question
- Adjust question so about 50% of class has wrong first answer
- Reinforce your concept with an explanation

*gain ~ (No. 2nd right – No. 1st right) ÷ (Total No. – No. 1st right)
So what about technology?

- Use it to make instruction easier
  - Use web-based tools for JiTT
  - Use PRS like tools to accept anonymous (to each other) student responses
  - Use web-based databases to locate good ConcepTests and publish yours
  - Use technology to identify effectiveness of ConcepTests
  - Use technology to make PI easier and more effective in class
Implementing PI in the classroom

- 384 instructors who used PI were surveyed*

- Good news first:
  - 90% of 30 courses who tested the students performed well in FCI
  - Nearly 80% said they would definitely use PI again
  - Wide range of courses – high school to universities

Issues faced by instructors

13% said creating material was difficult

A lot of material already exists for a number of subjects:

1. Physics: http://www.deas.harvard.edu/galileo
2. Chemistry: http://www.chem.wisc.edu/~concept/
3. Astronomy:
4. More subjects coming:
   Geology, Mathematics, ...
Issues faced by instructors

- 10% cited colleague skepticism
- Collect data assiduously
- Pit your results against courses with no PI on identical examinations
- Less combative approaches include asking colleagues to sit in class
Issues faced by instructors

- 9% said they didn’t have enough time to cover all the material in course

- A small fraction were able to reduce coursework. (This may not always be possible)

- Use JiTT to make students read and prepare before they come to class
Issues faced by instructors

- 7% cited student resistance to PI
  “some students were too cool, too alienated, or perhaps too lost to participate”.

- Impress upon students the rationale and value of PI
- Explain how PI works and why you believe it will work for them
- Regularly present class averaged grades to demonstrate its effectiveness
- Circulate - guide and encourage
- Give credit for participation
- Have CT like questions in exams
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For more information please visit:
http://mazur-www.harvard.edu
http://www.deas.harvard.edu/galileo
Useful Resources

- Old Project Galileo site (useful information on education research):
  - http://galileo.harvard.edu

- New Galileo site (updated ConcepTests and tools):
  - http://www.deas.harvard.edu/galileo

- JiTT web-site:
  - http://webphysics.iupui.edu/jitt/jitt.html

- Mazur Group papers & talks:
  - http://mazur-www.harvard.edu/library

- Prof. Mazur’s Spring Physics course web-site:
  - http://physics1.harvard.edu

- Suvendra Nath Dutta contact info:
  - Email: sdutta@deas.harvard.edu
  - Phone: (617) 495-9616