Peer Instruction: Methods and Techniques

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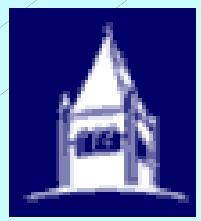


University of New Hampshire

22 July 2002

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

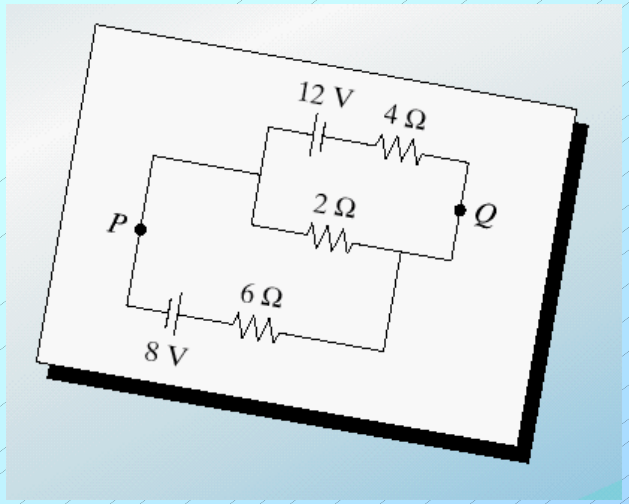
Nature of problem

- **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?

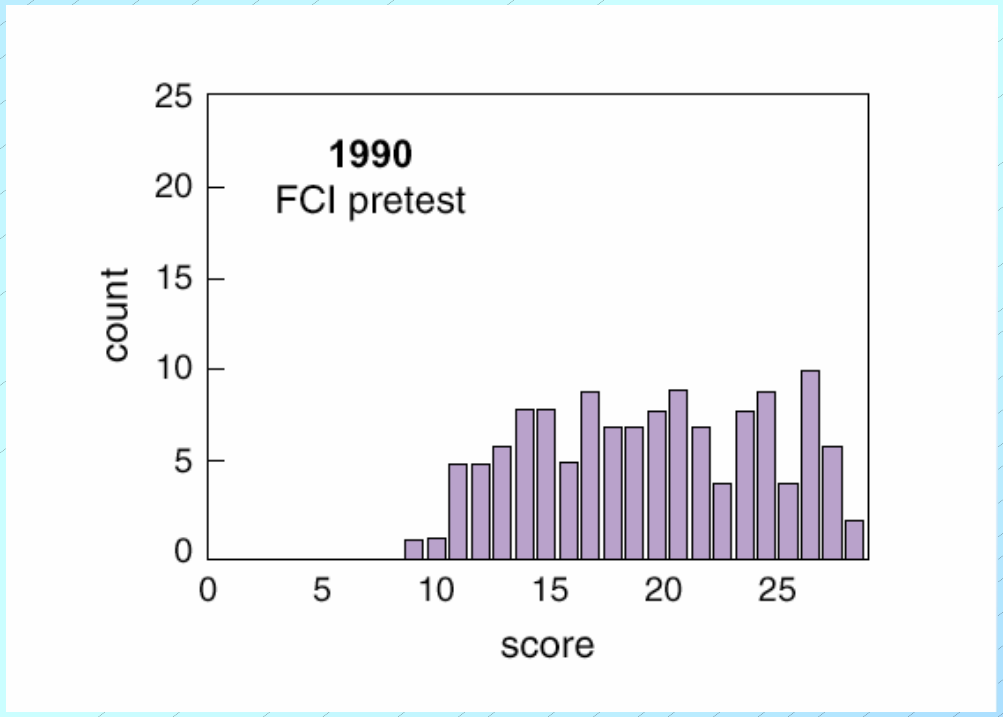
- **Lectures focus on transfer of information**
- **Conventional questions reinforce poor studying habits**

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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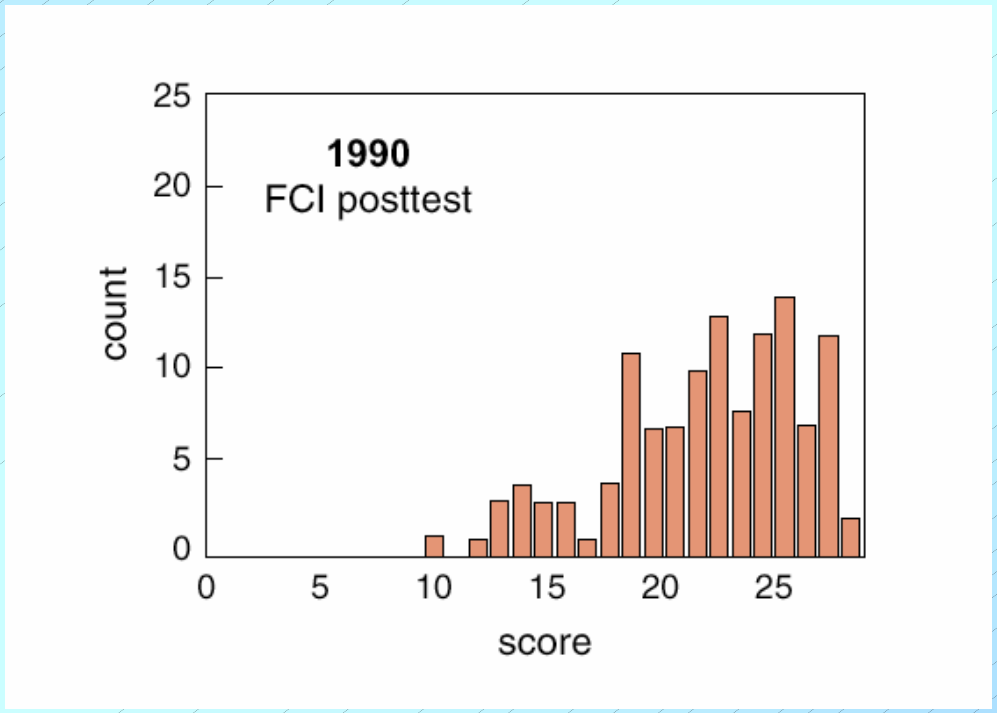

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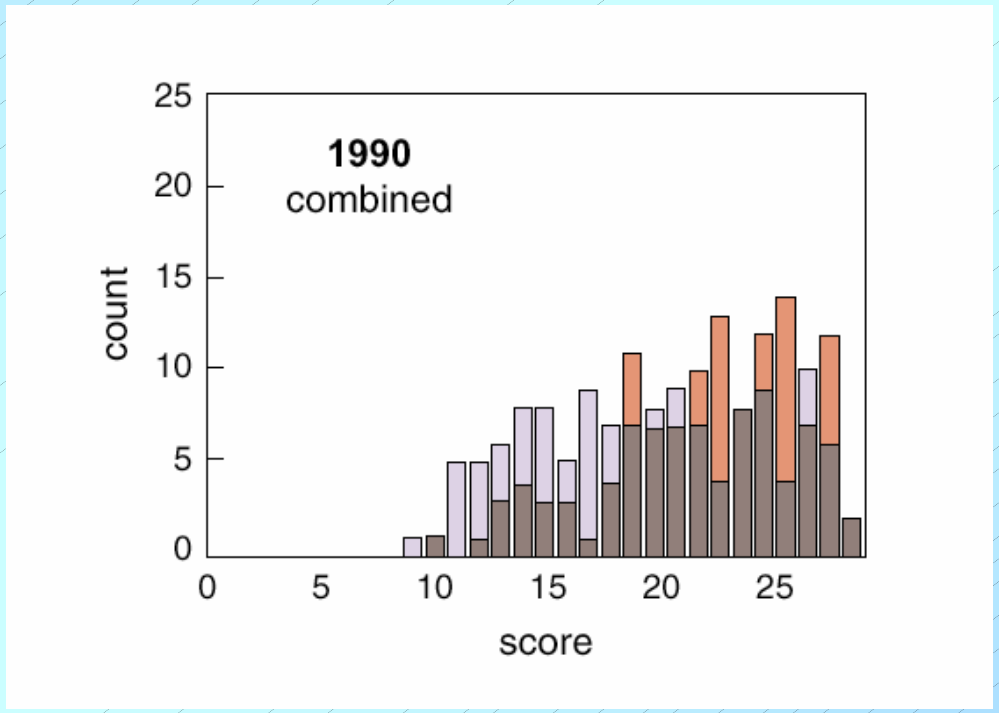

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What is the solution?

- **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

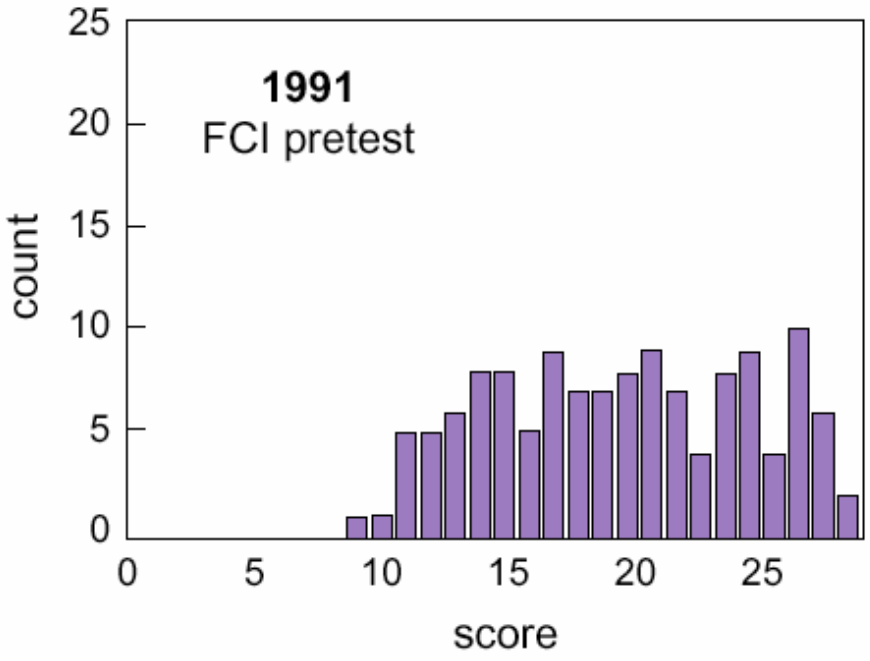
Ref: **Just-In-Time Teaching**: Blending Active Learning With Web Technology (Prentice Hall Series in Educational Innovation) by Gregor M. Novak (Editor), Evelyn T. Patterson, Andrew D. Gavrin
http://webphysics.iupui.edu/jitt/jitt.html

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**



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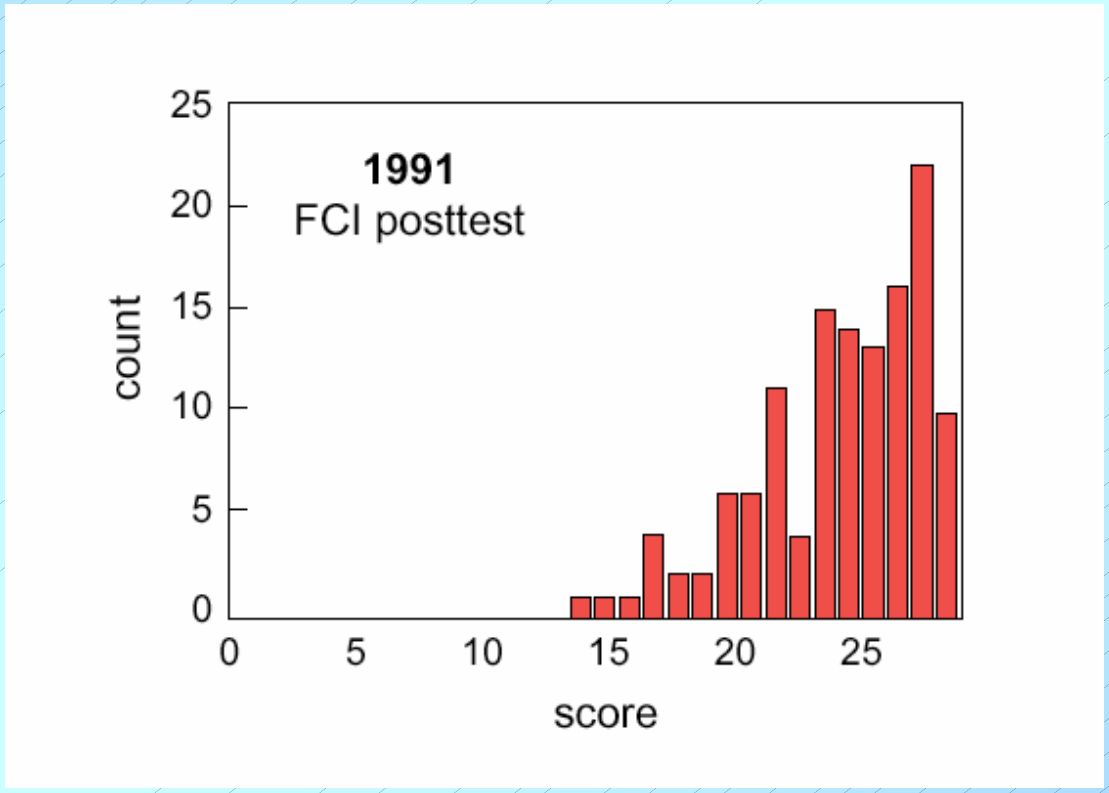

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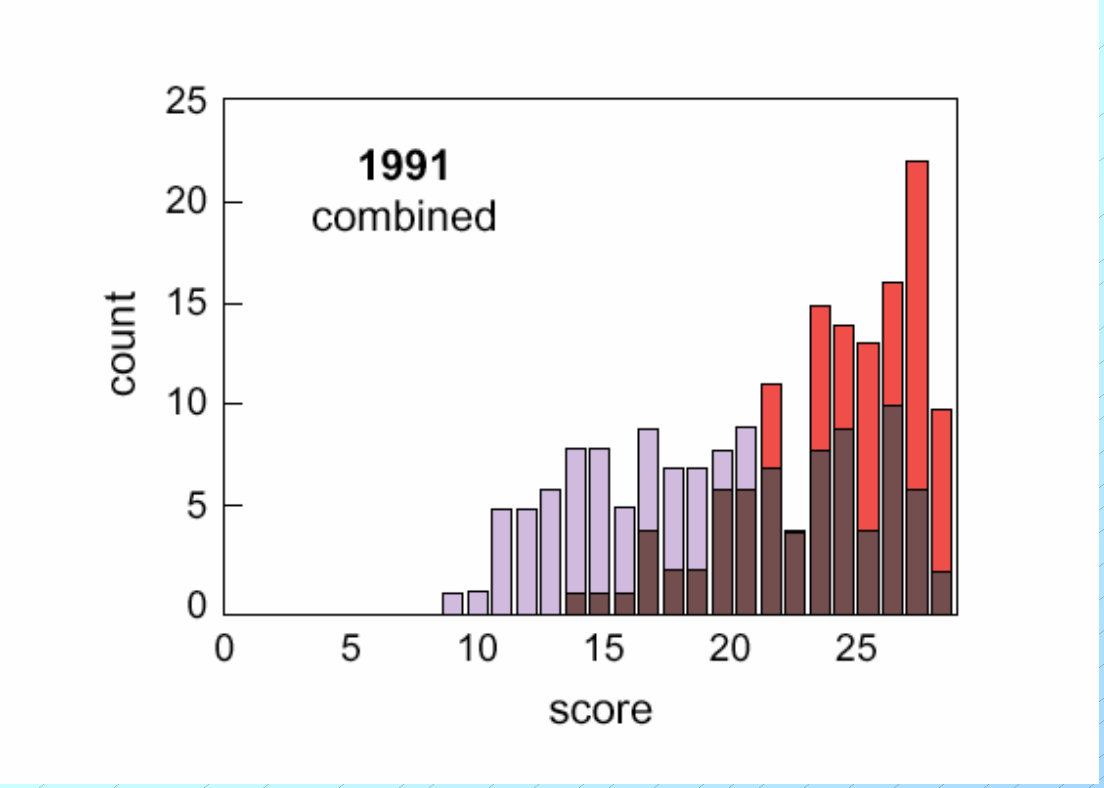

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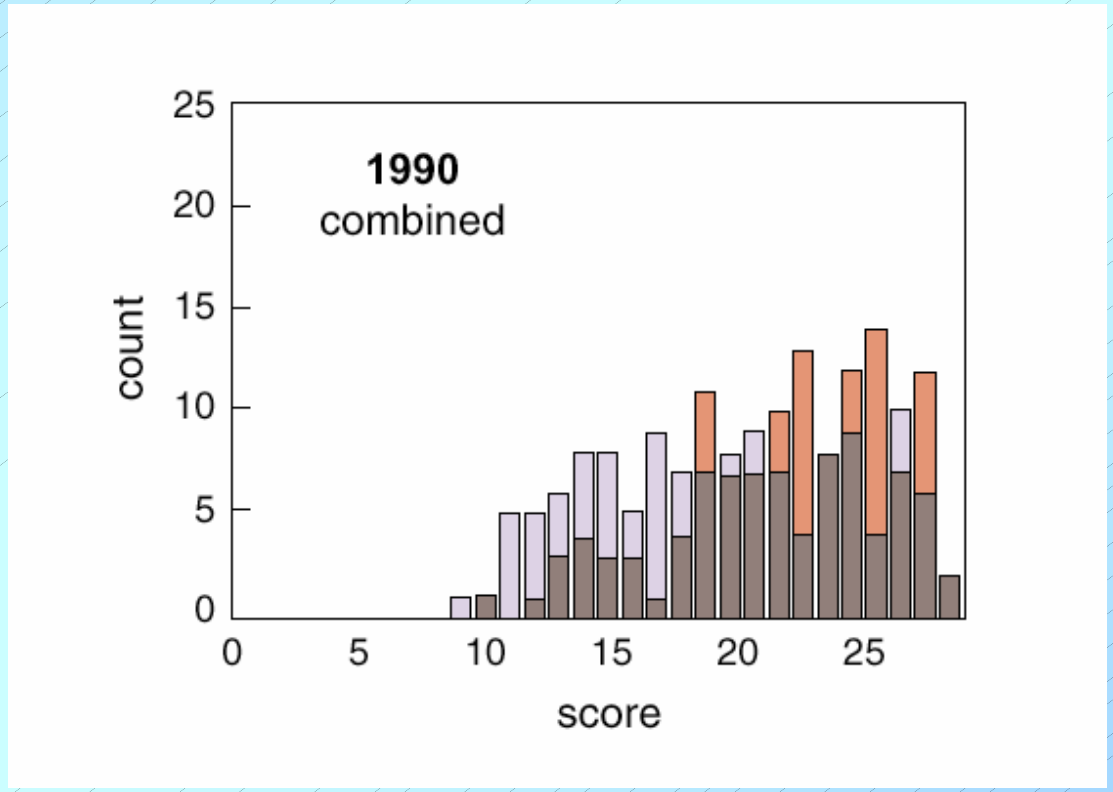

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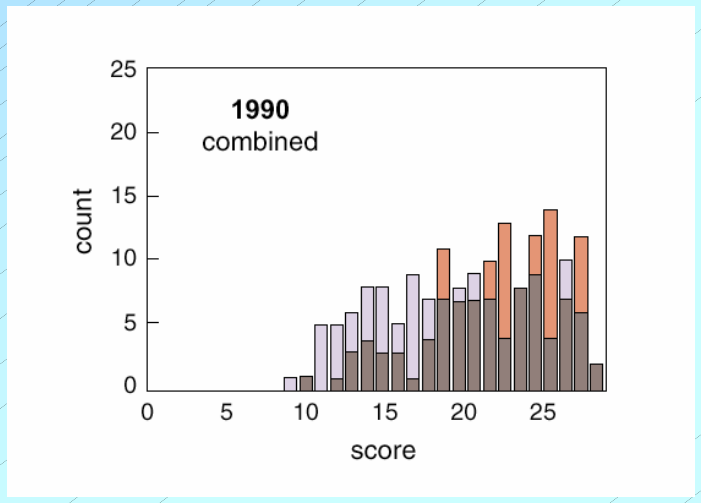
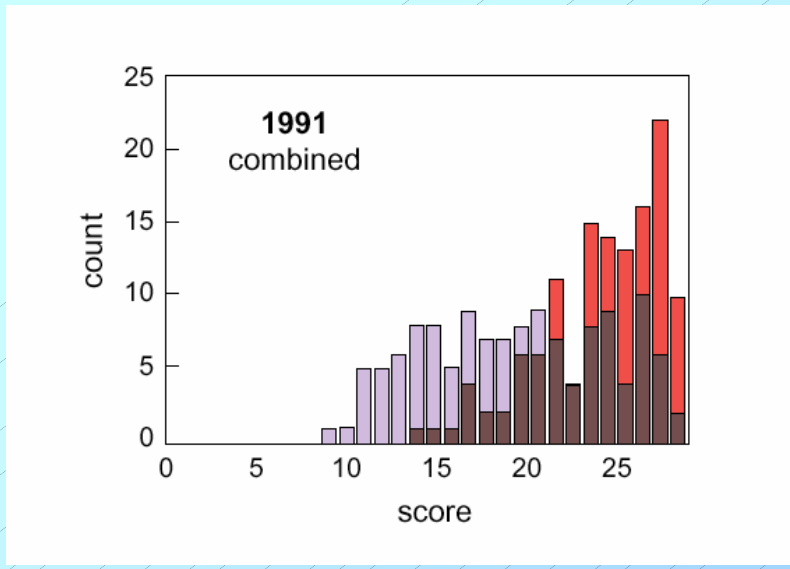
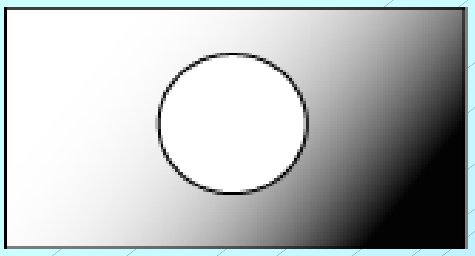




ConcepTest Design

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**

ConcepTest Design II

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

***Ref: Peer Instruction: Results from a Range of Classrooms,** Adam P. Fagen, Catherine H. Crouch, and Eric Mazur, *Phys. Teach.* **40**, 206-209 (2002).

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:
   http://hea-www.harvard.edu/~pgreen/educ/ConcepTests.html
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**

Acknowledgments

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DEAS Information Technology Group

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
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