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Using Peer Instruction for Effective Active Learning

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What is Peer Instruction?

Peer Instruction (PI) is an evidence-based instructional strategy that uses interaction to increase student learning. PI combines mini-lectures, clicker questions (ConcepTests), and small-group discussions to get students actively engaged with concepts to improve their mastery and long-term retention. Physicist Eric Mazur created the approach and described it in *Peer Instruction: A User's Manual* (1997) and has documented its impact on student learning in several articles. Two of Mazur's key findings are as follows:

- Students in physics courses using PI performed better on post-course assessments that emphasize conceptual understanding, as well as tests that focused on quantitative problem solving (Crouch & Mazur, 2001).
- Male and female physics students often showed 10-percentage point gaps on both pre- and post-course assessments. PI courses reduced or eliminated this gap on post-assessments, even if the pre-course gap existed (Crouch, Lorenzo, & Mazur, 2006).

Beyond physics, PI has also been shown to be effective in a wide range of science disciplines, including chemistry (Landis et al., 2001), computer science (Simon et al., 2010), and psychology (Chew, 2004). PI has also been used outside science fields, such as in philosophy (Butchart, Handfield, & Restall, 2009).

How does Peer Instruction work?

PI uses many techniques common to other forms of interactive lecturing. For instance, PI courses use pre-class reading quizzes, in-class demonstrations, and short activities. The distinctive feature of PI courses is the ConcepTest, a multiple-choice question targeting novices' common misunderstandings. PI courses repeat the following structure (15-20 minutes) multiple times per class session:

- 7-10 minutes: instructor presents a mini-lecture or activity
- 1 minute: instructor poses the ConcepTest question and gives students time to think
- 30 seconds: students commit to an initial answer using a clicker device
- 2-3 minutes: students discuss the question in groups of 3-4, aiming for consensus and explaining why the other answers are incorrect; instructor monitors discussions to keep students on task

- 30 seconds: students commit to a final answer with a clicker
- 2-5 minutes: instructor reveals correct answer and debriefs class; instructor can immediately adjust the discussion and next mini-lecture to resolve students' misunderstandings

Student responses can be collected using standard clicker devices, such as those purchased from TurningPoint. As an alternative, smartphone and web-based apps are also available, such as Socrative, Poll Everywhere, or TopHat Monocle.

What makes a good ConcepTest?
A good ConcepTest question should focus on a single concept that students often misunderstand, particularly when existing knowledge leads to incorrect intuitions. The question should target conceptual mastery rather than quantitative problem solving. All choices provided should seem plausible enough that only 30-40% of the initial responses are correct. As an example, consider the following question for a mathematics course on probability (D. Bruff, Vanderbilt University):

Your sister calls to say she's having twins (not identical). Which of the following is more likely?

A. twin boys

B. twin girls

C. one boy and one girl

D. all are equally likely

Why is PI effective?
Several features of PI align with well-established principles for effective learning (Ambrose et al., 2010). Specifically, PI uses discussion to organize both new and existing knowledge in a way that strengthens learning. PI also provides a means for students to practice applying concepts in a non-threatening manner as a step toward mastery. Some specific examples include the following:

- Talking about concepts helps to uncover inaccurate prior knowledge.
- Discussions link new concepts and prior knowledge, creating stronger memory structures.
- ConcepTests are low-stakes, allowing students to make and correct mistakes.
- The small-group discussion lets introverted students speak in a less intimidating social structure.
- The instructor can provide immediate and targeted feedback to correct common mistakes.

Additional resources to get started:

- Turn to Your Neighbor: The Official Peer Instruction Blog

- Peer Instruction Network
- Physics Education Research User's Guide on PI

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