A Research-Supported Idea for Effective Teaching:
The Exercise Comes First

Tal Gross
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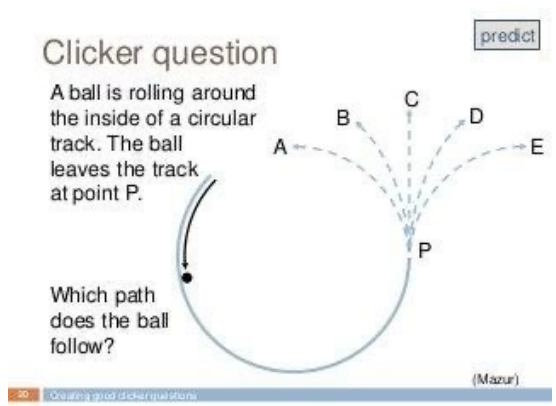
Imagine two undergraduate physics classes. The first class is entirely passive: the instructor lectures for 90 minutes. Historically, that's how most undergraduate physics classes have been taught: lecture and then a homework assignment.

The second class is different. That class is taught via a protocol called "peer instruction," a four-step process.

1. First, the instructor projects on the board a poll. An example is below. The poll is multiple choice, and all students in the class have to select an answer via PollEverywhere.



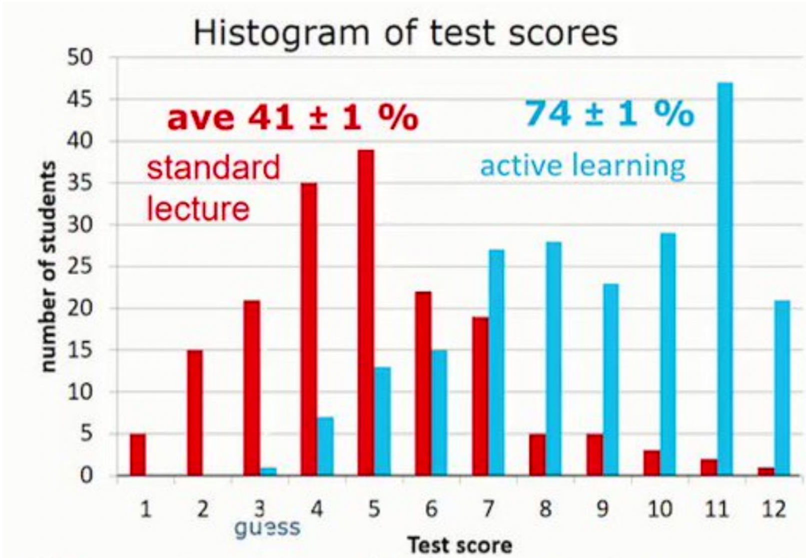

2. Second, the instructor asks students to "Turn & Talk." Students are asked to turn to their neighbor and explain why they chose the option that they did.

3. Third, the instructor asks all students to vote again. The instructor sees whether or not the choices of the students have converged.

4. Finally, the instructor gives a short lecture, explaining the concepts at play and the correct answer to the poll.

Peer instruction is essentially the opposite of the traditional, lecture-based approach. The standard approach has students listen to a lecture, and then do an exercise, a homework assignment. Peer instruction involves the opposite order: the exercise comes first.

Which method of teaching is more effective? The histogram below describes test scores for the two types of classes. (Source here.) Students who are taught via peer instruction score much higher on final exams. The entire distribution of test scores shifts to the right – it seems as though all students benefit from that approach. That finding has been replicated over and over again. There are even meta-studies.




Here's how one physicist describes the approach (source).

> There is much research showing that student learning is greatly enhanced, often by factors of two or three (as measured in diagnostic tests), if students struggle with a problem before they are told how to solve it. (cite, cite) There is also evidence that students who have learned concepts this way are better able to transfer those concepts to novel contexts. (cite, cite) So when teaching a key idea, an instructor should not start by explaining the idea and then giving students examples to practice on. Instead, the instructor seeks to do the reverse: First give students an example that challenges them to discover the key idea themselves, and then give them a mini-lecture that shows them how an expert would organize the problem. This suggests a strategy for selecting problems: Decide which topics warrant a mini-lecture, and then design a student activity that leads into each mini-lecture.

In other words, the suggestion here is to think of teaching as a two-step process. First, there's an exercise: a poll, a "Turn & Talk," a discussion. Second, the instructor delivers a short lecture. The exercise comes first.

In education it is very difficult to measure instructors' added value, how much their students are really learning. Student evaluations do not help – studies have shown that student evaluations are often *negatively* correlated with objective measures of learning. As a result, no instructor can argue: "hey, my students love the class, so I must be doing a good job."

If we can't measure added value reliably, then what can we do? We can measure the degree to which the instructor relies on research-supported methods. And the most basic guidance from research: the exercise is first.