How to Transform Learning-With Teaching

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How can we improve student learning in the State of Texas?

As educational leaders in the Lone Star State, this is the question of our lifetime.

The importance of the learning question is amplified by its complexity. If there was a simple answer, someone would have thought of it and implemented a solution by now. Given the current landscape of learning in our schools, we have an unprecedented opportunity to scan the rugged terrain we face—including dwindling resources and exploding demand for effective learning—and pioneer decisions that, even in difficult conditions, can maximize our students' potential to thrive in and contribute to our increasingly knowledge-based society.

The most powerful tool we have at our disposal in our quest to cultivate effective learning is teaching. In this article, I describe Peer Instruction, an innovative pedagogy known to significantly improve student learning across various subjects and institutional types.

Peer Instruction

Peer Instruction (PI) is a research-based pedagogy developed by physicist Eric Mazur in the 1990s at Harvard University. Mazur created PI when he realized his students were learning less than he expected and when he realized that his teaching was a primary contributor to their lack of learning. "When I first started teaching, I decided, simply, in terms of my approach, that I was going to do what had been done to me—lecture. My whole perception of teaching and my teaching career changed when all of a sudden it became clear that in spite of high evaluations and in spite of good performance, my students were not really learning very much in my classroom," says Mazur.

In response to this epiphany, Mazur created an interactive teaching method that research conducted at Harvard and elsewhere demonstrates increases student learning of concepts far better than traditional, non-interactive approaches. [1,2,3]

Peer Instruction is not limited to the college physics classroom. Texas elementary and secondary educators from across the State are registered members of the Peer Instruction Network (www.peerinstruction.net), the global community for current and future Peer Instruction users. Represented institutions in the network include Coppell ISD, Denison High School, Allen ISD, Rockwall, Parish Episcopal, Kimberlin Academy, Armstrong Elementary, Highland Park, Post Oak Academy, P.L Paschal, Wichita Falls, Cypress Fairbanks ISD, Concordia Lutheran, College Park, Cypress Ranch, Comal ISD, Leander ISD, and Dripping Springs Elementary.

Ryan Campbell, a junior high and an IB high school history teacher, uses Peer Instruction to help teach his students about primary and secondary sources and

source analysis.

Ryan said, "with the International Baccalaureate being a very demanding pre-university qualification, it was essential to find a way of maximizing class time for active engagement with the material, Peer Instruction seemed the best way to do it."

Indeed, the primary goal of PI is to promote student engagement with subject matter. To do this, instructors motivate students to cover material before class and then spend in-class time uncovering student confusion and misconceptions about subject matter. Class time consists of short mini-lectures on key concepts or topics, each followed by a ConcepTest—a short conceptual question related to the same topic. Instructors then engage in a variation of the think-pair-share model by giving students time to think and commit to an answer to the ConcepTest, and then asking students to turn to their neighbors to discuss their responses. In the next step, students again commit to an answer and the instructor uses student feedback to decide what to do next.

Each concept goes through the following workflow:
1. Instructor explains concept 2-5 mins.
2. Question posed 1 min.
3. Students given time to think 1-2 mins.
4. Students record individual answers
5. Students engage in peer discussion 2-5 mins.
6. Students record answers again
7. Teacher analyzes feedback
8. Explanation of correct answer from 2-5 mins. Instructor or individual students

PI leverages the power of social learning to confront students' misconceptions and activate their minds while providing instant feedback to faculty. Dr. Cassandre Alvarado, Assistant Dean for Undergraduate Studies at the University of Texas at Austin (UT) and the College Readiness Special Advisor to the Texas

Higher Education Coordinating Board says that PI helps students build key habits of mind necessary for success at UT. "PI helps students engage in the higher order thinking skills of metacognition and related activities, such as self-monitoring and self-regulation that are essential to succeed at the college-level and beyond."

Peer Instruction Implementation

One popular way to implement PI is using clickers, or classroom response systems. Instructors use a small USB-receiver with their computer to collect answers from students during number 4 and 6 of the ConcepTest workflow, submitted through small hand-held response cards. While they help logistically, clickers are absolutely not required for effective implementation of PI. Research demonstrates that, at least in college physics classrooms, lettered flashcards are as effective as clickers at increasing student conceptual understanding.

Peer Instruction and the Flipped Classroom

PI is one research-based method for flipping the classroom, in that it requires students to engage deeply in subject matter outside of class time and those uses class time to deeply engage in concepts.

We use a method called Just-in-Time Teaching (JiTT) to help motivate pre-class preparation. With JiTT, students do a low-stakes, online coverage assignment, where watch a video, complete a reading, or engage in some other kind of content transfer task. Next, students use the web (facilitated often by learning management systems) to respond two conceptually-based questions related to that content. These questions may be closed- or open-ended, but should not be questions that someone who has not engaged in the coverage exercise could answer. Students then answer a third feedback question such as, "What did you find most confusing about what you read. If you did not find anything confusing, what did

you find most interesting?"

We grade students only on their effort and analyze their feedback before class starts. A quick scan of their responses cues our selection of ConcepTests that will elicit, confront, and resolve the most problematic student misunderstandings.

"I don't go into the classroom lecturing on what I think students need to learn. They tell me what it is that they need my help with most through their JiTT feedback," says Mazur.

As experts in the flipped classroom, Brian Bennett, Dan Spencer, Jon Bergmann and colleagues state, "in most flipped classrooms, there is an active and intentional transfer of some of the information delivery to outside of the classroom with the goal of freeing up time to make better use of the face-to-face interaction in school."

According to Bennett and other flipped experts, flipped classrooms are not all alike – they imply that implementations can vary: "The flipped classroom is a pedagogy-first approach that strives to meet the needs of the learners in our individual schools and communities. It is much more an ideology than it is a specific methodology…there is no prescribed set of rules to follow or model to fit…Practitioners of the various flipped classroom models are constantly tweaking, changing, rejecting, adding to, and generally trying to improve the model through direct experience with how effective it is for kids."

That said, a fundamental implementation of the flip is to engage students in coverage activities before they come to class, typically via watching an online lecture or video, and interacting with peers and instructors using the web. This warm-up activity is distinct from homework.

As described above, in PI, students also do readings, or

some other coverage activity, before class and interact with instructors by engaging in retrieval practice in a low-stakes, formative assessment scenario. Retrieval practice is a cognitive science term that refers to activities where students work to pull information from their memories. Recent research demonstrates that retrieval practice plays a "critical role" in effective learning. Students further engage in retrieval effort in class through ConcepTests. In this way, throughout just one course where an instructor is using JiTT and PI, students are provided with hundreds of opportunities to engage in retrieval and thus, strengthen their learning in ways that will help them succeed well beyond the boundaries of one classroom.
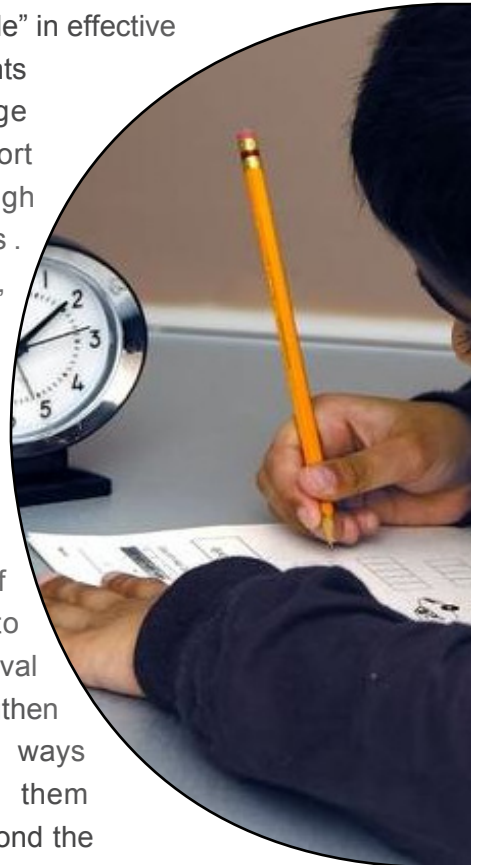
Summary

Peer Instruction is a proven method of teaching that significantly enhances student learning. Helping teachers learn to use low-cost, low-threshold research-based pedagogies is one step we can take as leaders to transform learning in our schools. To learn more about Peer Instruction, see our official blog, Turn to Your Neighbor, at blog.peerinstruction.net.

TexasASCD

1 Crouch, C. H., & Mazur, E. (2001). Peer Instruction: Ten years of experience and results. American Journal of Physics, 69(9), 970.

2 Fagen, A., Crouch, C, Mauzr, E. (2002). Peer Instruction: Results from a Range of Classrooms. Physics Teacher, 40, 206-209.

3 Smith, M. K., Wood, W. B., Adams, W. K., Wieman, C., Knight, J. K., Guild, N., & Su, T. T. (2009). Why Peer Discussion Improves Student Performance on In-Class Concept Questions. Science, 323(5910), 122–124. doi:10.1126/science.1165919

4 Lasry, N. (2008). Clickers or Flashcards: Is There Really a Difference? Physics Teacher, 46, 242–244.

5 Bennet, B., Spencer, D., Bergmann, , J. et al., (2012, April 16). The Flipped Class Manifest [Blog post]. Retrieved from http://www.thedailyriff.com/articles/the-flipped-class-manifest-823.php

6 See 2.

7 Karpicke, J. & Roediger, H.L. (2008). The critical importance of retrieval for learning. Science, 319(5865), 966-968.

About the Author

Dr. Julie Schell is the senior educational Postdoctoral Fellow within the Mazur Group of the School of Engineering and Applied Sciences at Harvard University and the Instructional Innovation Specialist for Readiness Texas at the University of Texas at Austin. Dr. Schell studies the diffusion and uptake of pedagogical innovation across diverse contexts. She is an expert in Peer Instruction and is the Co-Founder of the Peer Instruction Network, the global community for current and future Peer Instruction users. She has a doctorate in Higher Education from Teachers College, Columbia University and is the author of the official Peer Instruction blog, Turn to your Neighbor. Follow Julie on twitter @julieschell.

The Mazur Group is a research group in the Division of Engineering and Applied Sciences and the Department of Physics at Harvard University under the direction of Eric Mazur. In 1991 they developed an easily and widely applicable technique, called Peer Instruction, that encourages student participation and interaction in large lecture classes. The group is currently involved in studying gender differences in physics education and the effectiveness of demonstrations. For more information go to: http://mazur.harvard.edu/about.php