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Make it RISE: Principles for Effective Learning

by Michael S. Kirkpatrick

Over the past couple of decades, the evidence supporting the use of active learning (using in-class activities that compel *all* students to discuss concepts in small groups, answer questions independently, or solve problems collaboratively) has continually been growing (see Hake 1998, Prince 2004, and Freeman et al. 2014). In a new paper, Deslauriers et al. (2019) report on a carefully designed randomized experiment that used identical materials and explanations in both an experimental group (lectures accompanied by attempts to solve problems before example solutions were provided) and a control group (lectures that involved copying solutions to problems solved by the instructor). In both runs of the experiment (so both groups experienced both learning conditions), the active learning group did better on objective tests of their mastery of the concepts, although the control group reported (incorrectly) greater self-assessments of how much they learned and understood (which is a topic for a different discussion!). To understand why active learning leads to better observable learning outcomes, we can look to several well-established and empirically grounded principles in the learning sciences. Four principles, which can be linked with the acronym RISE, provide guidelines to follow when trying to create effective learning activities:

Retrieval practice (also called the "testing effect"): Attempting to recall information—whether that information is a relevant fact or how to apply a critical thinking process—strengthens our underlying memory structures, increasing both the long-term retention and quick access to the information later. When instructors provide testing opportunities in a low-stakes classroom setting and give immediate verbal or written feedback, powerful learning is possible. One simple way to do this is to start each day with a question about the previous class's discussion. Another is to have a mid-class quiz (low-stakes and maybe even ungraded) about the material just discussed; IF-AT forms, clickers, or online polling technologies (Slido, PollEverywhere, Socrative) are great ways to provide immediate feedback.

Interleaving: Switch between topics or related tasks—instead of focusing on the same idea repeatedly until desired mastery is achieved—helps us to develop a stronger sense of key and nuanced differences. Also, our minds like novelty, and these switches can keep students interested and focused. As an example for a math course, students could be asked to draw a graph of equation A, solve equation B, and find the maximum value of equation C. Then, within the same class or study session, they interleave the tasks and equations by solving equation C, finding the maximum of equation A, and graphing equation B. During the interleaved practice session, students may make mistakes and performing the tasks slowly, but they tend to do better (more accurate and faster) when tested on these tasks and ideas later.

Spacing: Distributing learning practice over a period of time produces better long-term learning (known as the "spacing effect") than a longer study session crammed into a short period of time. We've all heard and experienced that cramming (more formally known as "massed practice") may

lead to a short-term performance boost. The problem is that the performance boost doesn't last; the benefit of massed practice disappears even when the test is given only a week later. As an example of how to benefit from the spacing effect when teaching, before introducing a new concept in class, pose a question or a problem to students that requires them to recall ideas from earlier in the same week or from the previous week. The time gap between exposure to the information and the attempt to use it reinforces long-term retention.

Elaboration: The process of explaining new information in terms of existing knowledge (i.e., elaborating on a new concept by putting it into your own words) creates rich memory structures that facilitate attempts to recall that information later. The think-pair-share technique (think about an answer for a minute, discuss the answer in a pair with another student, then share with a full-class discussion) is an easy way to support this practice of elaborative encoding, as students put ideas into their own words. Another approach is to give time for silent reflection and written response (e.g., a "minute paper"), which gives all students—including introverts or others who may need time to process an idea—a chance to elaborate on their ideas.

By keeping these principles in mind when designing in-class activities, instructors can feel confident that they are helping their students to achieve more durable learning gains. If you're looking for more ideas about how to apply these principles to your own discipline, *Classroom Assessment Techniques: A Handbook for College Teachers* by Angelo and Cross (1993) is a wonderful resource with clear step-by-step descriptions of several activities that can be used.

To learn more:

- *Make It Stick: The Science of Successful Learning* by Brown et al. (2014)
- *How Humans Learn: The Science and Stories behind Effective College Teaching* by Eyler (2018)
- *Understanding How We Learn: A Visual Guide* by Weinstein, Sumeracki, and Caviglioi (2018)
- *How Learning Works: Seven Research-Based Principles for Smart Teaching* by Ambrose et al. (2010)

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