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Brain Science in the Classroom

By Benedict Carey

The most valuable course a student could take is not currently a part of any standard curriculum. It's Learning 101—specifically, how the brain picks up knowledge and skills most efficiently.

If taught properly, it's a course that would be lively, rigorous, and immediately useful. Over the past 100 years, cognitive psychologists have assembled an impressive collage of surprising findings—i.e., learning tactics—and rooted them in a fertile, disarmingly ingenious theory that puts a new slant on many old education debates.

It's exciting stuff, it's fun to teach, and the reason it's not widely known is that learning scientists have largely toiled in their labs, far away from schools and educators. They speak a different language; they focus primarily on individual learners; they prefer controlled conditions to dynamic classrooms.

That's all beginning to change, and quickly. The U.S. Department of Education has made it known that its research arm will fund only rigorous trials to test specific learning techniques, drawing straight from this cognitive tradition. A host of innovative double-blind randomized trials are **underway** in public middle schools in Philadelphia and Tampa, Fla., among other cities.

Yet teachers are far and away the most critical component in this potential integration. They're the ones who will judge which lab-learning techniques actually extend to the classroom (some certainly will not). And it's their commitment—or skeptical reluctance—that will determine whether these principles of learning science will have as huge an impact as claimed.

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Thankfully, the science is as accessible as it is surprising.

The basic idea is this: The brain as a biological organ has not adapted to institutional education, at least not entirely. For as much as we learn in class, the old-school advice on studying—keep to a ritual, avoid all distractions, find a quiet study space, hole up with the books—is severely

limiting. The brain is a quirky learning machine, the science shows, and it works best when those quirks are exploited.


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Take so-called spaced study, a technique that's already familiar to most teachers and students. Many of us heard it first from our mothers: "Honey, why not study an hour today and an hour tomorrow instead of doing it all tonight?"

Good advice. Very good, it turns out. People who split their study in this way remember up to two times more on a test (say, in a week) than they would had they studied the same material in one night. Two times. Without having worked harder or spent more time.

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Why? Because in the second study session, the student does three things: searches for, brings to mind, and then re-stores the information. This threefold mental act is vastly different from simply reading over the material again in a single session. And it's a far deeper learning experience.

Another example is mixed practice, or what scientists call interleaving. Interleaving is a technique discovered by sports researchers, beginning in the 1960s. They found that athletes sharpened their skills, whether hitting a baseball or a badminton serve, most quickly when they practiced them in mixed sets. That is, instead of devoting a large block of time to one skill (say, hitting a curveball), it was better to execute several skills (curveball, fastball, sinker) in one session.

How so?

Again, the brain learned to learn (evolutionarily speaking) out in the world, executing skills not in isolation but mixed with others—hunting, tracking, foraging, making split-second decisions. This technique is hardly confined to athletics. In the case of math tests in particular, students must learn to distinguish types of problems before solving them. Math teachers know this too well, having watched students who do very well on unit quizzes collapse on cumulative exams, in which choosing the proper approach is as important as executing it.

Doing mixed-problem homework assignments forces them to do just that. In **studies ongoing** in Tampa, researchers have found that this technique—simply mixing math homework assignments—has improved test scores by almost 50 percent. No change in teaching, no disruption in normal class, no top-down reform required. In effect, the students are doing review-like assignments every day, rather than at the end of a given unit.

Improvements in testing do not get much higher than 50 percent.

Creative assignments like term papers and art projects are another matter altogether. No lab study can possibly capture the ineffable steps that go into completing those longer-term, individual exercises. Still, the science can clearly illustrate exactly what happens mentally as people work their way through. Simply starting work on such beastly things—making an outline, say, and no more—sets in motion mental machinations that "feed" the mind more material each

day, in observations and thoughts. This happens automatically, and knowing how it does sharpens the process for the learner.

One college writing teacher at Southern Illinois University, Ronda Dively, designed **her curriculum** to exploit precisely this process, and as a result has gotten papers that are far more creative and original than those she graded before incorporating the science of "percolation," as I call it.

These kinds of techniques are effective because they trade on the piecemeal, foraging habits the brain developed when humans themselves were foraging for food and shelter.

"You would think that by now we'd have a really good handle on how we learn most effectively," Robert Bjork, a psychologist at the University of California, Los Angeles, and the dean of the field of learning science, told me. "But we don't, and so many of these findings do indeed come as a surprise."

Most education reforms have a grandiose odor to them. Let's revamp teacher training. Rethink the entire curriculum. Introduce more tests, more evaluations, more oversight. Reshape the education system top to bottom, so it looks more like Finland's, or Japan's.

The science of learning offers something at once humbler *and* grander: small techniques that can be deployed right away—today; now—and have outsized effects. Teaching this science directly, in a dedicated course, would offer not only an exquisite introduction to brain science, but also a means to strategize when studying. Think about it. So often, we study on hope and prayer; we hope we're doing it right, and we pray it's the right material. Far better to have tactics: to tailor technique to the material, the trap to the prey.

Learning 101 is coming to a school near you. Teachers already have many of the instincts captured by this compelling research. They should be the ones leading the way, not following.

Benedict Carey is a science reporter at The New York Times who focuses on brain and behavior topics. His latest book is How We Learn: The Surprising Truth About When, Where, and Why It Happens (Random House, 2014).

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