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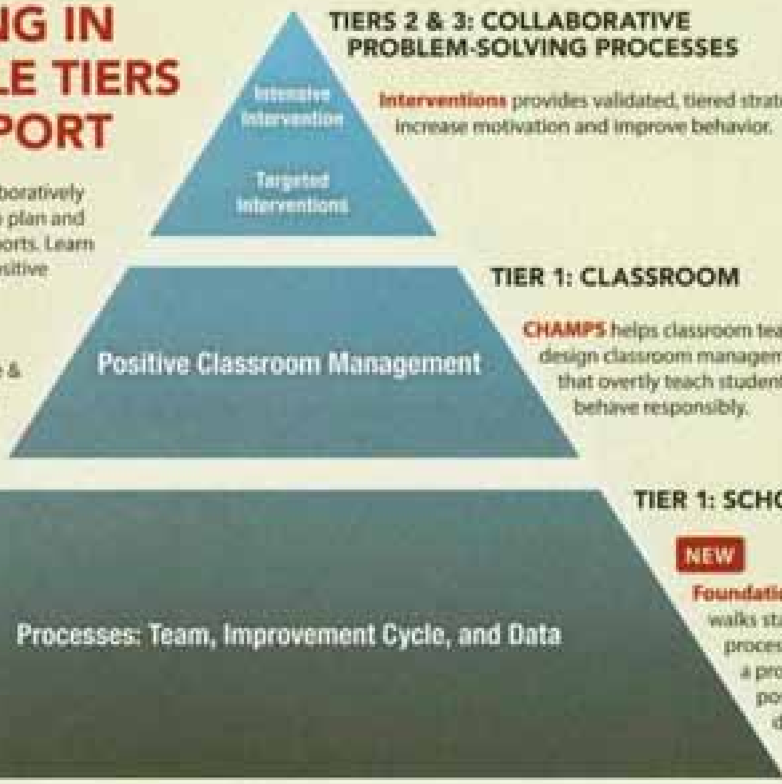

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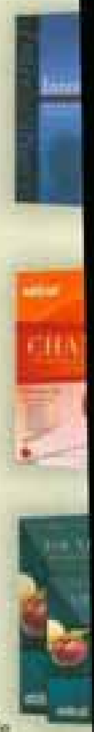

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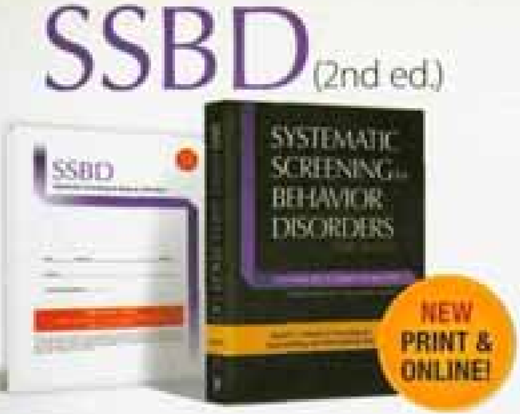

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EL Study Guide

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ASCD Guest Bloggers:

Robert Slavin, Susan Brookhart, and Dan Rothstein

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Donna Wilson and Marcus Conyers

How metacognitive thinking can spur learning gains.

How to Combine Rigor with Engagement

Sarah Fine and Jal Mehta

How schools can deepen learning for students.

The Right Questions

Dan Rothstein and Luz Santana

Instruction takes root when students ask their own questions.

Move It or Lose it!

Linnea Lyding, Debby Zambo, and Cory Cooper Hansen

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- *Elizabeth City* on how to encourage thoughtful student discussions—and roadblocks to avoid
- *Eric Palmer* on the importance of presentation skills
- *Timothy Rasinski* on how oral language can lay the foundation for reading
- Plus articles on math sharing, wait time, collaborative talk, debating controversial topics, vocabulary building, encouraging ELLs to converse in English. . .

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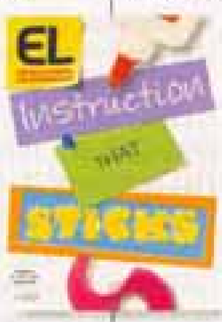
Marge Scherer

Do-It-Yourself Learning

A student prepares for tomorrow's big test by rereading a chapter on the War of 1812 and by highlighting every name, date, and passage that strikes her. The next day she remembers her facts, and she gets the *B* she was aiming for. But the following week, she can't tell you much about the war—except that she thinks it happened in 1812.

A teacher helps a struggling reader with the words he misses by stopping him every time he stumbles. She's trying to guide him to look more closely and hear the sounds in his head. But other than recognizing a few more words, the student doesn't improve much and is beginning to hate reading.



Most teachers recognize these practices—and have most likely engaged in them at some point. Cramming and hovering do work—if only for the short term. They are based on commonsense ways of thinking, but they don't actually take into consideration some of the more fundamental principles of learning and teaching.

This issue of *Educational Leadership* addresses the question, How do students learn for the long term? Our authors' research-based answers, although familiar enough, also pack some surprises.

Ultimately, learning is personal. As our lead author Daniel T. Willingham (p. 10) writes, much of what we learn depends upon ourselves. The act of highlighting text does help us remember because we must choose what to focus on. But if we go further and think deeply about the meaning of what we read, see, or experience, that understanding is more likely to stay with us for a longer time. If we puzzle over something enough *and* get corrective but supportive feedback, that learning may stick with us for a lifetime. Getting all students into a state of active engagement with the content is what makes teaching so complex.

Learning must make sense to the learner. In examining the most effective ways of teaching reading, Richard Allington (p. 16) notes that good readers pay attention to making sense. Thus, the more effective teaching practices involve asking higher-order questions, engaging students in discussion, and asking students to respond in writing to high-level questions. Instead of trivial, low-level interrogation techniques, effective teachers make literate conversations the aim.

Learning goals must be transparent. Knowing what and why you are learning something can make the difference in long-term learning. "If the teacher is the only one who understands where learning should be headed, students are flying blind," Susan Brookhart and Connie Moss (p. 28) note. They outline how to line up a "parade of learning targets" that shows how today's lesson builds on yesterday's and leads to tomorrow's.

See Robert Slavin's (p. 22) update on cooperative learning to learn how important it is for students to know both their group's goal and their own. Having study buddies is important, and so is knowing that your role in the group is vital to its success.

Learning involves "desirable difficulty." In the struggle to make something our own, we learn. Thus, as Henry L. Roediger III (p. 42) tells us, practicing a set of mixed problems is preferable to working many similar problems together because mixed practice requires more thinking. Comparing works by Degas, Cassatt, and Renoir makes you think harder about the art of each than does memorizing lists of characteristics of Impressionist paintings. And tests don't have to be the enemy of learning. In fact, frequent low-stakes quizzes and self-testing can enhance the process of learning. We've all been in the position of feeling we've understood what we've read only to realize we are stuck when we attempt to explain something out loud.

Timing matters. As Bryan Goodwin (p. 77) reminds us, the answer to the question of which strategy works best at any given moment depends on where the student is in the learning process and what the teacher and learner are trying to accomplish. The teacher still has to engage in do-it-yourself learning about what is working in his or her own classroom.

The strategies in this issue are not the only solutions—and they're certainly not the simplest ones. If all learning is do-it-yourself, another adage also holds true: The best teachers are learners. We hope the insights from these authors guide you in your long-term understanding of how students learn—and how you can better teach them.

DOUBLETAKE

Research Alert

Less Structure, More Self-Direction?

Students with good executive function have a jump on school success because they're able to self-regulate their behavior. They can make plans, finish their work on time, decide on midcourse corrections, and ask for help—all helpful skills for getting instruction to stick.

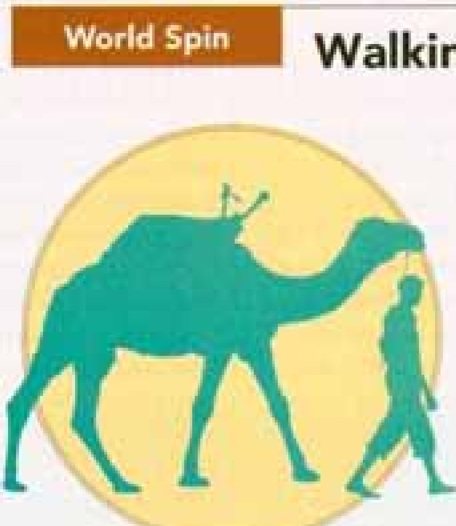
So how can we best develop these skills? A recent report suggests a relationship between self-directed executive function and the time children spend in less structured and more structured activities. The authors found that 6- and 7-year-olds who spent more time in less structured activities, such as trips to museums, libraries, and sporting events, displayed better executive function than those who spent more time in structured activities. Less structured activities appear to give children more opportunities to practice self-direction, whereas more structured environments seem to slow the development of self-directed control because adults are continually providing the children with external cues, reminding them what they need to do and when.

The authors note, however, that the children in the sample came from a suburban context—and that less structured time in suburban environments may be safer, quieter, and more resource-rich than such time in more impoverished environments. Nevertheless, the study raises an interesting question about how children's use of time has changed over the years, how we adults let them use that time, and how this can affect children's development.

The report, *Less-Structured Time in Children's Daily Lives Predicts Self-Directed Executive Functioning*, looked at 70 6- and 7-year-olds in a variety of structured and nonstructured environments. Written by Jane Barker, Andrei Semenov, Laura Michaelson, Lindsay Provan, Hannah Snyder, and Yuko Munakata, the article appears in the June 17, 2014, issue of *Frontiers* and is available at http://journal.frontiersin.org/Journal/10.3389/fpsyg.2014.00593/full.

World Spin

Walking the World



The Out of Eden Walk. Follow journalist Paul Salopek as he retraces on foot humans' migration out of Africa. His 21,000-mile, 7-year journey started in Ethiopia and is continuing across the Middle East, into Central and Northern Asia, and down the Americas to Terra del Fuego. According to the website, "Moving at the slow beat of his footsteps, Paul is engaging with the major stories of our time—from climate change to technological innovation, from mass migration to cultural survival—by walking alongside the people who inhabit them every day." Go to http://outofedenwalk.nationalgeographic.com to share in the adventure.

ScreenGrabs

On TED-Ed (http://ed.ted.com), teachers can find curated educational videos and easily create customized lessons around them. For example, for

- English teachers: "What Makes a Hero?" at http://ed.ted.com/lessons/what-makes-a-hero-matthew-winkler
- History teachers: "A Digital Reimagining of Gettysburg" at http://ed.ted.com/lessons/a-digital-reimagining-of-gettysburg-anne-knowles
- Math teachers: "The Infinite Life of Pi" at http://ed.ted.com/lessons/the-infinite-life-of-pi-reynaldo-lopes

NUMBERS OF NOTE

Who's for the Flip?

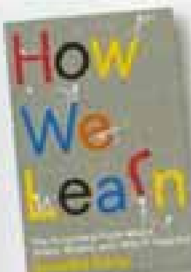
75 The percentage of U.S. secondary students who said a flipped classroom would be a good way for them to learn.

62 The percentage of U.S. secondary students who said they'd be more successful in a flipped classroom.

41 The percentage of administrators who say preservice teachers should learn how to set up a flipped classroom before being credentialed.

Source: Project Tomorrow/Flipped Learning Network. (2014). *A second year review of flipped learning and 2014 trends in digital learning: Students' views on innovative classroom models.* Irvine, CA: Author.

Relevant Reads



How We Learn: The Surprising Truth About When, Where, and Why It Happens by Benedict Carey (Random House, 2014)

"Like so many others, I grew up believing that learning was all self-discipline: a hard, lonely climb up the sheer rock face of knowledge to where the smart people lived," writes Benedict Carey. Yet as science reporter at the *New York Times*, Carey kept coming across cognitive research showing that the brain is a quirky, eccentric learning machine that actually works in an entirely different way.

For example, the brain finds nonsense offensive. And it doesn't take orders well—as we realize when we forget precious facts needed for an exam while somehow remembering the lineup of the 1986 Boston Red Sox. We can strengthen memory and comprehension, Carey writes, if we understand the brain better.

App-propos

Educreations (www.educreations.com) lets you create easy-to-follow tutorials, which you can couple with audio and video, to help students review material before an assessment or to provide additional assistance to struggling students.

And if you need to refer to state and national standards on the fly, try Mastery Connect (www.masteryconnect.com/learn-more/goodies.html). In addition to apps for the Common Core State Standards and the Next Generation Science Standards, Mastery Connect is rolling out custom apps for every U.S. state. (Apps for nine states are now available.)

PageTurner

Asking "Which teaching strategy works best?" is like walking into a gym full of workout equipment and asking a trainer, "So . . . which exercise is best?" —*Bryan Goodwin, p. 77*

Strategies That Make Learning Last

Students typically rely on four study strategies that don't work. Here are four that do.

Daniel T. Willingham

Research-based practices: The term has been reiterated so often that it's become nearly meaningless. In an effort to reinvigorate it, I'll offer two ways educators can effectively apply research to practice.

The first is through testing specific classroom procedures and materials. Typically, teachers can tell whether something is working in their classrooms, but that outcome may be idiosyncratic and depend on such factors as the particular students they have that year.

The second way is by illuminating fundamental principles of how students think and learn. Every teacher has a theory of how children learn; the theory may be unstated, but every teacher takes actions (or refrains from taking them) in the belief that doing so will help kids learn better. If researchers could offer principles of memory that are relatively universal across students, materials, and contexts, now *that* would help educators. The fact is, we want students to learn efficiently when we ask them to study on their own.

Learning to Teach Oneself

In the early years of schooling, we don't expect students to be able to guide their own learning; the teacher is largely responsible for creating classroom experiences that lead to student learning. But as kids get older, we accord them increasing responsibility. By middle school, it's routine to expect that students can read a chapter from a textbook at home and come to school the next day having learned the contents, ready for a discussion and later, a test. So, by this age, we're asking students to teach themselves. How do they learn this skill?

Researchers have asked college students how they study, and the results show that most use inefficient strategies (Hartwig & Dunlosky, 2012; Kornell & Bjork, 2007). They haven't really learned the skill of reading complex text, figuring out what's important, and committing it to memory. Interestingly enough, the initial studies queried students who had been quite successful, having gained admission to selective colleges. These students seem to have used inefficient means to get there.

These results fit well with another, highly informal finding from my own teaching. Each year, I ask the 350 students in my Introduction to Cognition class at the University of Virginia whether they were taught study techniques in K–12. Typically, 80 to 90 percent say they were not.

We want students to learn efficiently when we ask them to study on their own.

What Students Typically Do

So how do students usually study—and what's wrong with it?

The typical student employs four study strategies. First, he reads the assigned chapter, trying to understand individual sentences as he goes but not necessarily ensuring he's got the overall gist. Second, as he reads, he marks what he takes to be important points with a highlighter. Third, he doesn't look at the chapter again until a day or two before the test. Fourth, in preparation for the test, he rereads the chapter, focusing on what he highlighted earlier.

Clearly the first strategy is not optimal. Students need to be sure they extract all the meaning from their reading. The fact that not all do should make us suspicious of the second strategy, highlighting. How can you know what's important enough to highlight if you don't understand everything you read? And indeed, experiments indicate that students—especially poor readers—don't highlight what experts agree are the most important parts of texts. One might think, then, that highlighting would work better if an expert marked the important passages, but experiments show mixed results for that strategy as well. It may be that using someone else's judgment of what's important is mentally passive; it's the act of deciding what to highlight that provides a memory boost (Callender & McDaniel, 2009).

When they return to the chapter in preparation for an exam, most students' go-to strategy is rereading. As we'll see, rereading provides a relatively weak boost to memory compared with other study techniques they might use. But it helps enough that students can squeak by on an exam.

It's in that narrow sense that the third strategy—not studying until the last minute—pays off. We've all overheard students saying that they passed a test but forgot everything in a day or two. They aren't kidding. In one experiment, college students took the final exam for their course and then three days later took a different final exam that wouldn't count toward their grade. Students averaged 74 percent correct on the real final exam, but in three days they forgot so much that they scored, on average, just 29 percent (Rawson, Dunlosky, & Sciartelli, 2013). No wonder, then, that teachers so often see blank faces when they mention a concept that a colleague assured them was covered the previous year.

So what can we do to ensure learning that lasts?

Four Good Ways to Learn

In a recent review of the learning literature, my colleagues and I (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013) identified four useful study techniques, each with a substantial research base of both laboratory and classroom studies. Let's take a look at each one.

Elaborative Interrogation and Self-Explanation

Students use these two techniques as they're reading. With *elaborative interrogation*, you periodically consider the relationship between what you're reading and what you already know. With *self-explanation*, you periodically (say, every few paragraphs) explain to yourself *why* assertions in the text are justified (Rosenshine, Meister, & Chapman, 1996).

For example, suppose a high school junior read the following:

> By the year 1650, the center of gravity of the civilized world had shifted from Italy to Northern Europe. The obvious reason is that the trade routes of the world were different since the discovery and exploitation of America. (Bronowski, 1973, p. 221)

The student using elaborative interrogation would ask herself how this passage relates to what she already knows. She knows that Christopher Columbus first traveled to North America in 1492 and therefore notes that the author's description of "exploitation" must have occurred during the intervening 150 years. Another student might use self-explanation while reading the passage. He asks himself why trade routes would make Northern Europe "the center of the world." He's unsure of the reason but guesses it might be because of the money that would accrue from booming trade, or perhaps "center of the world" is meant literally as a sort of crossroads.

The students using elaborative interrogation or self-explanation may be able to use other parts of the text to confirm the accuracy of his explanations—or they may not. Even without corrective feedback, these techniques may still help comprehension in two ways.

First, they call attention to the meaning of the text; to implement these techniques, you must first understand what you read. Surprisingly, many students (but especially poor readers) set a low bar for what it means to "understand." If there are no unfamiliar vocabulary words and if each sentence seems sensible, they figure they're getting it (Markman, 1979).

Second, comprehension clearly requires coordinating meaning *across* sentences, and elaborative interrogation and self-explanation encourage that. In addition to aiding comprehension, these techniques help memory by encouraging students to think about meaning. Thinking deeply about meaning is a well-established technique to help cement information into memory (Craik & Tulving, 1975).

The advantage of elaborative interrogation and self-explanation is that students can learn these techniques easily. Teachers do need to model them, but it doesn't take a lot of practice for students to get the idea. The disadvantage is that they're hard to use if a student has little knowledge about the topic of the text.

Distributed Practice

Suppose a busy high school student decides he'll devote 10 hours to study for an upcoming Spanish test. What would be the best way to allocate those 10 hours? One hour per day for 10 days? Two hours per day for five days? And if he decides, as he's likely to do, to cram most of his study time into the day before the test, what consequences does that strategy have for memory?

Cramming practice into the hours right before a test is actually an effective strategy—provided you don't care that you'll swiftly forget what you've learned. For longer retention, spacing practice out is much more effective. In one experiment, college students were taught a new mathematical procedure. Everyone practiced the procedure 10 times, but some students got all 10 problems at once, whereas others got five problems on each of two occasions, separated by a one-week delay. When everyone was tested a week after they had practiced, all were equally successful in solving problems with the procedure, getting about 70 percent of the problems right. But when tested again three weeks later, those who had all their practice jammed together got, on average, just 32 percent correct, whereas those whose practice was divided into two sessions showed much better recall, scoring, on average, 64 percent correct (Rohrer & Taylor, 2006).

Implementing this strategy is, in one sense, easy—you just separate the study sessions. But by how much? That depends on how long you want to remember the material. Roughly speaking, study sessions should be separated by 10–20 percent of the time that you'd like to remember something. Hence, if you hope to remember something for a year after you last study it, separate your study sessions by 1 or 2 months. Much of the time, our answer to, "How long should

students remember this?" will be "ideally, forever." That goal indicates that students should revisit crucial material in subsequent years. But, of course, repetition need not be exact and can be incorporated into more advanced material.

Cramming isn't a good strategy even for shorter-term learning. The fact is, many students simply aren't that good at arranging their time or don't make scheduling study sessions a priority. For these students, infrequent tests mean infrequent studying. Teachers can discourage cramming and encourage students to keep up with the content by giving frequent low-stakes quizzes or frequent assignments that require some study.

Interleaved Practice

Suppose a student plans to spend an hour studying Spanish vocabulary on a particular night. Would it be better for her to study an individual word until she feels she's mastered it—or mix up the word list?

It seems intuitive that it's better to study the whole list rather than focus on one word at a time. This strategy is called *interleaving*, and it applies not just to a single list but to broader principles. For example, if you're trying to learn what makes a Monet look like a Monet, it's helpful to contrast his paintings with those of other impressionists, and that's easier to do if you see a Cassatt or Renoir right after seeing a Monet (Kornell & Bjork, 2008).

As obvious as this principle seems, it's seldom observed in science and math textbooks. Typically, a new concept is introduced in a chapter; some sample problems are solved step-by-step; and a set of practice problems appears at the end of the chapter, all of which draw on the same concept algorithm. The drawback is that the student gets no practice discerning one type of problem from another; he knows that each problem in the set calls for the same basic strategy.

Implementing interleaved practice is not terribly difficult, but it does call for a bit of planning. What's needed is study and practice of different concepts *within a single session*. If curricular materials aren't set up for this sort of learning, it's up to the teacher to do a cut-and-paste job.

Another difficulty is that students feel they're learning less, not more, and indeed, they have a tougher time when problems are interleaved. This makes sense: If a homework assignment asks the student to do 15 problems, all of them variants on the same mathematical algorithm, the student will have an easier time than if the 15 problems call for any of five different algorithms. But even as the student struggles with the latter assignment, she's learning when to use which algorithm. Teachers who use interleaving should suggest various strategies that students might use to identify different problem types. Later, perhaps on a unit test, that practice will pay off—but now the student who practiced one problem type at a time will struggle (Taylor & Rohrer, 2010).

Practice Testing

This final technique has something in common with the retrieval called for in interleaved practice: It feels to the student like it doesn't work. But rooting around in memory, trying (perhaps struggling) to remember something, is actually a great way to ensure that the memory sticks. Because the student may struggle (and even fail) to remember, it feels fruitless; wouldn't time be better spent reading over the material again? But study after study shows that taking a brief quiz is better for memory than rereading (Agarwal, Bain, & Chamberlain, 2012). The largest benefit to memory occurs when the student gets immediate corrective feedback. But even if there's no feedback, and even if the student fails to remember the answer, the quiz is still better for memory than rereading!

Further, the boost to memory can be quite long-lasting. For example, in one experiment (McDaniel, Agarwal, Huelser, McDermott, & Roediger, 2011), 8th graders took three low-stakes quizzes over the course of a science unit. On an end-of-unit test, students scored 13–25 percent better on the material that had appeared on the quizzes. (The questions probed the same knowledge but were not identical.) Most impressive, the gains lasted to cumulative semester and end-of-year tests.

It's *trying to remember* that drives the practice-testing effect. Although there are different ways to prompt that effort, a quiz is probably the most straightforward way to get students to probe their memories, so that's the most commonly used technique in the classroom. Whether you use a quiz or something else, it helps if you provide feedback. That is, if the student searches memory for a fact and can't find it, you should make that fact available.

You can also encourage students to use this strategy themselves if they're studying on their own. Testing yourself (using flash cards, for example) is not only an efficient way to ensure that memory is robust and long-lasting, but also a reliable way of evaluating whether you know something well enough or need to continue studying. If rereading is the main study activity, it's all too easy for the student to become convinced that she knows the material; after rereading a chapter several times, it will all seem quite familiar.

For example, a student studying biology may feel that the phases of meiosis are very familiar when he reads about them in a textbook, but when pressed, he can't describe them. It's only when he looks away from the text and tries to reproduce the information that he realizes he's stuck.

Rooting around in memory, trying to remember something, is a great way to ensure that the memory sticks.

A Sensible Caveat

Each of these techniques has been studied, not only in the laboratory, but also in classrooms (see Brown, Roediger, & McDaniel, 2014; Carey, 2014). They've been tested with a variety of subject matters and across different age groups, so there's good reason to think they'll work for you.

Still, memory is just one part of what happens in a classroom. The techniques described here are useful additions to a teacher's toolbox, but using them could also have unforeseen consequences on other student outcomes. To use an extreme example, constant quizzing might be good for memory, but it would be detrimental to motivation. As always, teachers can capitalize on research findings to improve their practice, but they should temper those findings with professional experience for use in the classroom. ■

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READING MOVES:

WHAT NØT TO DO

In almost every early elementary classroom, you'll see students reading aloud and answering questions about what they've read. It's time for that to change.

Richard L. Allington

Some instructional moves are so common that almost no one notices them anymore. That's true of two moves I observe teachers using for reading instruction in almost every elementary classroom I visit. Both moves—interrupting students to correct their mistakes during oral reading, and asking students low-level questions after they've finished reading—are widespread, despite the fact that no good evidence has ever supported them as effective. At best, both of these moves are unproductive; at worst, they undermine our children's literacy development.

MOVE 1.

Overusing and Misusing Oral Reading

I've been conducting observational studies of classrooms for four decades, and today I observe more oral reading than ever. The sheer volume of oral reading is disturbing, as is the practice of using oral-reading speed and accuracy to make judgments about reading development. In a classic study, Mosenthal (1977) demonstrated that oral reading and silent reading are different processes; a student's skill in oral reading says little about his or her silent reading proficiency, and vice versa.

According to an evaluation of the federal Reading First program (Gamse, Jacob, Horst, Boulay, & Unlu, 2009), our current fascination with oral reading speed has resulted in students who can read aloud faster and more accurately but whose silent reading comprehension has not improved. Given that independent reading with good comprehension is the ultimate goal of literacy instruction, it's puzzling that oral reading activity is so prevalent.

Creating Two Types of Readers

If teachers must continue to use so much oral reading, they should at least reduce its harm by suppressing their tendency to interrupt readers to correct every mistake. The effects of this widespread practice are especially pernicious for struggling readers.

Over 30 years ago, I conducted two observational studies in elementary classrooms, which not only found that oral reading was prevalent, but also that it was used differently with good and with poor readers (Allington, 1980, 1984). One difference was the amount of oral-reading practice that students experienced. Good readers were more likely to read silently during their reading lessons than were struggling readers. Because most people can read much faster silently than they can read aloud, the result was that struggling readers read fewer than half as many words daily as good readers did. This deficit in sheer reading volume is exactly the opposite of what lagging readers need (Torgeson & Hudson, 2006).

Even more troubling than the simple loss of reading practice, though, was the tendency for classroom teachers to interrupt struggling readers both more often and differently than they interrupted

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good readers. Teachers typically interrupted struggling readers immediately, even before the student had pronounced the whole word that was causing difficulty. In contrast, teachers waited longer before interrupting good readers, usually until the end of the sentence or even the end of the page.

These differences in the timing of interruptions may explain another observation: Teachers tended to correct struggling readers by focusing on surface-level features while encouraging good readers to self-monitor. Consider what happened when a good reader made an error in reading the sentence *John went to the store.*

> GOOD READER: John went to the *stone.*
>
> TEACHER (*after the sentence is completed*): Does that make sense to you?

The student then reread the sentence, correcting his mistake.

Now consider what happened when a struggling reader misread the same sentence.

> STRUGGLING READER: John want—
>
> TEACHER (*interrupting and pointing at the word* went): Look at the vowel in that word.

This interruption led to a bit of unsuccessful word work by the student, followed by the teacher pronouncing the word for him. The student then continued to read.

> STRUGGLING READER: . . . to the story.
>
> TEACHER: That e is a silent e. Try it again.

How can we be surprised when these different instructional moves create two different types of readers? Unfortunately, my current observations have found that reading instruction is continuing to separate students into two groups—good readers who self-regulate, and struggling readers who stop after almost every word and look up at their teacher for a cue (Allington, 2012). These differences are not inherent in the struggling readers; rather, they're caused by variations in where teachers direct the students' attention. Good readers learn to pay attention to making sense; struggling readers learn to focus on letters and sounds while paying almost no attention to making sense of what they read.

> "How can we be surprised when **such instructional moves create two different types of readers**?"

Refining Oral-Reading Practice

To avoid the harm inherent in the overuse and misuse of oral-reading practice, consider the following recommendations:

- Use oral reading selectively. By the middle of 1st grade, most reading should be done silently.
- If you elect to have students read a text aloud, consciously bite your tongue as they read. Wait until the student has completed at least a full sentence before you interrupt, and then interrupt with a comment that encourages the student to self-regulate.
- Ensure that other students who might be following along or listening to the student read aloud also do not interrupt the reader.
- If you're concerned that you cannot monitor the accuracy of students' reading when they read silently, remember that all you really need to do is ask them to retell what they've read. Misreadings become obvious during retellings.

MOVE 2.

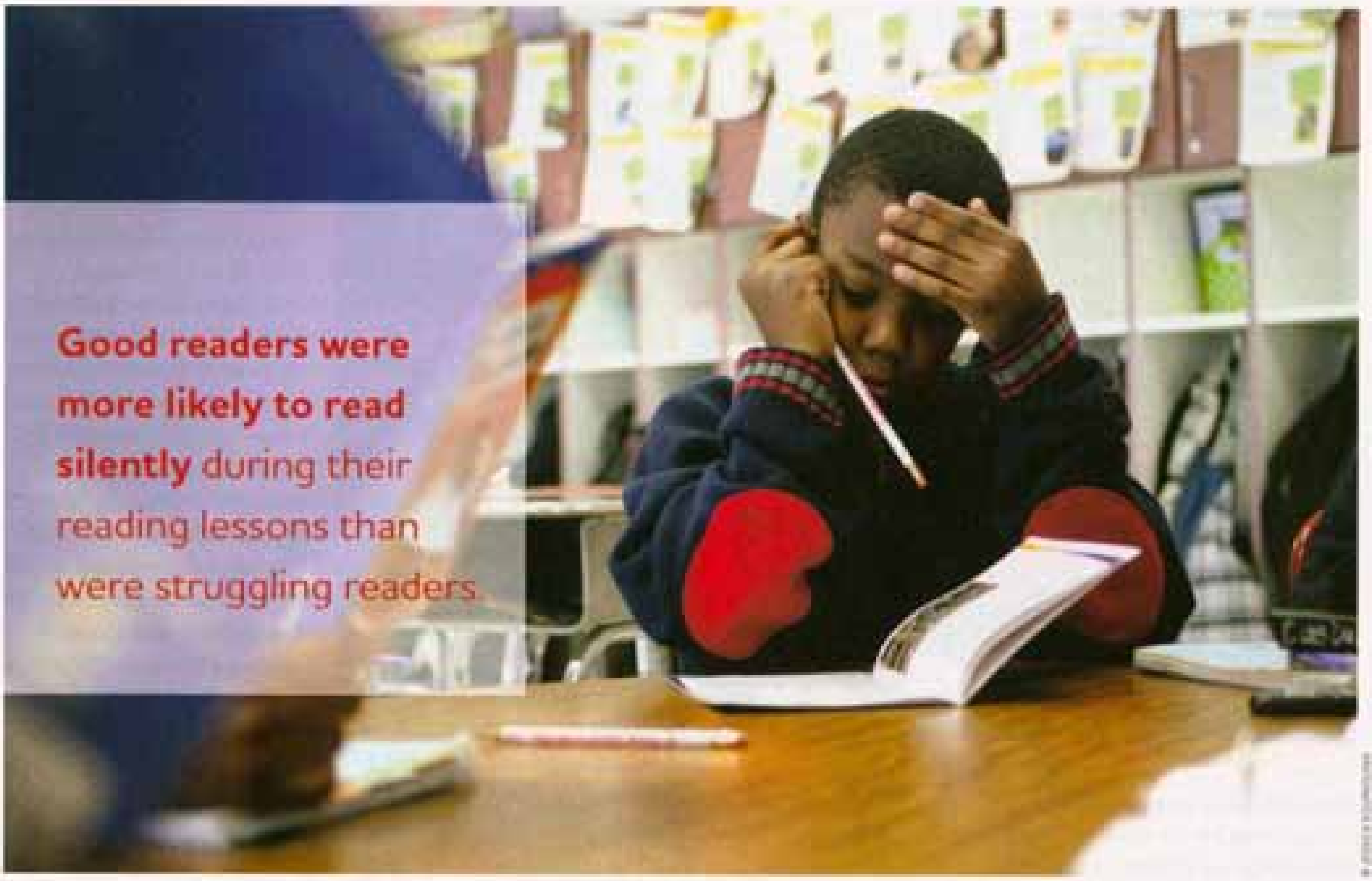
Asking Low-Level Questions

The second misguided but common instructional move that I observe in classrooms is asking an interminable number of low-level, literal questions after (or during) reading. I know that the teacher manuals that accompany commercial reading series are filled with such questions. I'm unsure why, when not a single study demonstrates that this practice actually leads to improved reading comprehension.

Too many of the reading lessons I observe focus on these trivial questions while ignoring how well kids actually understand the text they just read. Sadly, except in a few exemplary classrooms, I almost never witness true literate conversations—the kind that people outside classrooms engage in to make meaning of a text they care about, whether a newspaper article, a memo from the school superintendent, a novel, or a biblical passage.

The Need for Literate Conversations

Imagine that you're sitting in a coffee shop one morning reading the local newspaper when a friend walks in and asks, "Have you read the story about the tornado in Johnsonville?" You respond, "Yes, I just finished it." If your friend were then to subject you to the sort of low-level questions found in most reading series ("What was the fire chief's name?" "What color was the car that was destroyed?") you would probably look at her somewhat grumpily and wonder what was wrong with her. Instead, your friend would be more likely to ask something along



the lines of, "That tornado was terrible, wasn't it?" You might respond, "Yes, it was a miracle that nobody was killed!" Your friend might respond with a comment about the article's assessment of Johnsonville's emergency alert system. And thus the literate conversation would begin.

The same sort of literate conversation occurs when someone has read the novel you are currently reading. Two literate adults do not quiz each other on low-level, factual details in the texts they've both read. Instead, they often begin with something like, "How do you like that book?" The literate conversation then follows.

It's unfortunate that our classrooms so often replace literate conversations with interrogations about trivial details. Unfortunate, because we have good evidence that engaging students in literate conversations with their peers is a powerful instructional strategy for fostering both short- and long-term reading comprehension (see Fall, Webb, & Chudowsky, 2000; Malloy & Gambrell, 2011; Nystrand, 2006). Classroom discussions do not need to take up vast amounts of instructional time; research has demonstrated that even brief opportunities for discussion can improve students' understanding of texts and their performance on traditional assessments of reading comprehension (Applebee, Langer, Nystrand, & Gamoran, 2003).

In a study of high-poverty schools, Taylor and colleagues (Taylor, Pearson, Clark, & Walpole, 2000; Taylor, Pearson, Peterson, & Rodriguez, 2003) found that more effective teachers asked five times as many higher-order questions and offered twice as many opportunities for discussion as less effective teachers did. The more effective teachers were also more likely to ask students to respond in writing to higher-order questions. Writing after reading, holding classroom conversations about texts that students have read, and responding to higher-order questions are all linked to higher student achievement. But none of these three instructional moves are routinely observed during classroom reading lessons.

Why Do We Stick with the Trivial?

Given the evidence that low-level interrogation routines are ineffective, why do they continue to be such a

common instructional move? One reason may be the current practice of labeling the ability to answer multiple-choice questions on standardized achievement tests as "reading comprehension."

A second factor may be the widespread use of commercial core reading programs that provide almost no suggestions for discussion. Twenty years ago, a colleague and I noted that 98 percent of the questions offered in a commercial reading series were low-level, literal questions (Allington & Weber, 1993). More recent research shows that this proportion seems to be holding true in core reading programs (Dewitz, Jones, & Leahy, 2009).

Third, there's evidence that most teachers are ill-prepared to initiate and manage classroom discussions. Kucan, Hapgood, and Palincsar (2011) found that relatively few elementary teachers were skilled in developing high-quality classroom discussions. Only 15 percent of the teachers they observed could specify the difficulties that students might have with the texts they were given. Most of the teachers did not offer effective support; instead of leading discussions flexibly, they relied on probing for general information and directing students to reread.

Improving Classroom Discussions

This research suggests that teachers must begin to develop their expertise in initiating and managing classroom discussions. Because most students have had little experience with discussion, teachers will likely need to develop students' ability to engage one another as conversational partners.

One instructional move that you can use to do this is *turn, pair, and share*—having students turn to a student sitting nearby and talk, even briefly, about a text they have just read or listened to. You might initiate turn, pair, and share by providing a specific structure—for example, requiring that one student talk for the first minute of the activity, followed by a minute for the other student, and ending with a minute in which both students are free to take turns talking to each other.

It may also be useful to model how such conversations might proceed and to help students learn appropriate ways to disagree or challenge a response (for example, by saying "I disagree, and here's why"). For teachers worried about the volume of the noise created when multiple pairs are discussing the text, remember that you can model "whisper talk" as an alternative to full, and often loud, conversation.

A specific turn, pair, and share prompt might be to ask students to discuss whether a character in the story reminds them of anyone. Alternatively, you could ask students to discuss their responses to a higher-order question about the text that they have read. For example, when students are reading *The One and Only Ivan* by Katherine Applegate (HarperCollins, 2012), you might ask, "Do you think that animals really remember things that happened long ago the way Ivan recalled what had happened to his mother and father?" After a few minutes, you can ask one or more pairs to share how their discussion concluded.

Turn, pair, and share enables students to talk through their understandings of what they have been reading. As students develop greater capacity to engage in peer-to-peer discussion, you can ask pairs to jointly

The teacher manuals that accompany commercial reading series **are filled with low-level, literal questions**.

write about what they have been discussing. As always, providing a model of what this writing might look like will ease students into this more complex task.

Don't be surprised if many students appear confused or incompetent when you first integrate paired discussions into instruction. Be patient; nothing worthwhile is easy to accomplish. Start with brief turn, pair, and share sessions. Over time, as students become more competent, you can extend sessions and broaden them so the groupings are no longer restricted to pairs but include three to five conversation partners.

Of course, strategies like turn, pair, and share—which enable every student to participate—take more time than teacher-managed discussions in which only a few students are usually involved. But engaging students in literate conversations about what they've been reading must become a common instructional move. You can find time for such discussions by restricting the number of low-level literal questions you ask.

Time to Reconsider

In the end, students are more likely to learn what was taught than to learn what was never taught. Because of schools' overemphasis on oral reading, our students have demonstrated improved oral-reading rates and accuracy but have failed to demonstrate self-regulation or better reading comprehension. Because of schools' failure to make literate conversations a staple of reading instruction, our students daily demonstrate their ability to respond to low-level questions while failing to demonstrate higher-order understanding of what they read. To make literacy instruction more effective, we need to reconsider and fine-tune these common instructional moves. ■

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Making Cooperative Learning POWERFUL

Five key practices bring out the tremendous potential of this approach.

Robert E. Slavin

Just about everyone loves the *idea* of cooperative learning. Think of kids working productively and excitedly in groups, everyone getting along and enthusiastically helping one another learn. Think of kids completing great projects together, encouraging one another, and forming friendships. In this ideal scenario, all students are engaged, active, and minds-on. They are learning cooperation itself, an important life skill. Cooperative learning: how pro-social, how liberating—and how does anyone really accomplish this?

Cooperative learning can be wonderful. Students often love working this way. I've heard comments like, "An explanation is easier to understand if it's coming from

An effective cooperative group is not a collection of kids **thrown together** for a brief activity.

another kid" or "My teammates . . . make sure I understand the work." But for many teachers who've tried it, cooperative learning is a noisy mess rather than a stairway to heaven. One student might be doing all the work while the others socialize, for example. Kids may ignore or belittle group mates they perceive to be low achievers. Some students may think cooperative learning is party time rather than learning time. This is why studies find that most teachers don't use cooperative learning regularly, despite extensive research supporting it (Gillies, 2014; Roseth, Johnson, & Johnson, 2008; Slavin, 1995, 2013; Webb, 2008).

It is the "learning" in cooperative learning that is too often left out. But it needn't be. Using these five strategies, teachers can get the greatest benefit possible from cooperative learning and ensure that collaboration enhances learning.

1. Form interdependent teams.

An effective cooperative group is not a collection of kids thrown together for a brief activity. It's a team composed of diverse students who care about helping one another learn—and about the success of the team itself. All members must know they can depend on one another for help.

In the forms of cooperative learning we've used for years at Johns Hopkins University and at the Success for All Foundation in elementary and secondary schools (Slavin, 1995), we group students into four-member teams (if the class doesn't divide evenly, we have a few five-member teams). A foursome provides flexibility. Some activities can be done in pairs and some with the whole team. Teams work together daily for 6–8 weeks; after that period, teachers assign new teams.

Team members move their desks together and choose a team name. At the beginning of the team's work, members engage in group bonding activities, like creating a motto or coat of arms to express their team personality.

In middle or high school, groups might investigate careers that interest them and colleges known for majors tied to those careers. Their research often culminates in each team giving a presentation about why they recommend a particular college, and teams sometimes name themselves after the school they recommend. Even if students choose Duke because of basketball fame, they've spent time helping one another learn something new, shared what matters to them, and met a deadline.

It's best if teams are composed of a cross section of the class: high and low achievers, boys and girls, students of different ethnicities. Groups definitely won't have such diversity if students choose their teams, so the teacher should make team assignments.

2. Set group goals.

Too often in cooperative learning, students are put into teams and instructed to "help one another." Helping one another is a good thing, but kids will do a lot more of it if they share a team goal.

A team goal is a target, product, or indicator that shows a team has done a good job of getting every member to perform at his or her personal best. A team goal could be increasing the average score on a quiz that all students take individually after they help one another prepare. It could be one overall product with individual components that each team member clearly contributed to, such as by coding a specific part of a computer program or contributing essential data to a group lab report.

In each case, a teacher both looks at the team average and evaluates the individual products. Teams whose work meets certain criteria are awarded certificates or small privileges. This helps team members see their joint work as achieving something important. Teams that don't have a goal are like sports teams in a game where no one knows, or cares, what the score is—not the sort of game in which all players do their best.

3. Ensure individual accountability. This is the essential element most often left out of cooperative learning—and when it is, teachers lose a lot of cooperative learning's potential.

Individual accountability means that to reach the team goal, all team members must master the targeted content or skills. Team success should depend on the hard work—and therefore the learning—of all members.

To understand why this is important, consider a team working together *without* individual accountability. Imagine that a team studies together and then takes one quiz, on which all team members can help one another. This arrangement will likely produce two undesirable outcomes: the *free rider* and the *know-it-all*.

Free riders do little work. They may chat with others, but they don't try much to learn or help others learn. "The others will do it anyway," they reason. "Why should I try?" Students who have doubts about their own skills may be shy or reluctant to participate if they know others will do the work.

Helping one another is a good thing, but kids will do a lot more of it if they share a team goal.

The know-it-all is another story. A know-it-all (or two) may dominate the group and tell others the answers. I once saw a group of middle schoolers trying to solve a complex math problem together. (Their task was to solve the problem and give the answer as a group.) Two kids were doing most of the talking. When one of their (usually quiet) teammates ventured an opinion, both know-it-alls shushed her and told her to wait for them to deliver the answer.

How can teachers ensure individual accountability? First, make sure the team goal requires the learning and participation of all team members. For example, if the team goal is to score an average of 80 percent or better on a quiz, all students need to do well. Or a goal might be to write an outstanding report on a given country, with each chapter signed by a team member. Never choose an outcome one student could do alone. In addition, frequently reinforce the idea that the purpose of the team is to make sure that all members are learning, not just to get the right answers or complete the project. Explain why individual accountability is fair; students will readily understand why no team member should get a free ride.

During lessons, use informal cooperative structures that reinforce the idea of individual accountability. Teachers we work with in Success for All programs, for example, make frequent use of a technique called "random reporter." Each student is given a number from 1 to 5. When teachers ask a question, they direct it to a team and then pick a number at random. The student on that team with that number has to respond for the whole group—and the team can earn points based on the answer.

Practices like random reporter communicate consistently that teams must make sure all their members learn. Potential free riders understand that they will be held accountable and that they can't wait for their teammates to make all the effort. Know-it-alls realize that if they don't engage, teach, and give feedback to every team member, their team won't succeed. One middle school math teacher noted, "Students . . . know they need to work hard on math problems and be ready to explain them. If they aren't ready, they can't get off the hook easily."

Finally, it's important that the teacher lets the work be challenging and doesn't step in too early to do the work for students who struggle. Doing so not only undermines teammates' developing interdependence, but also teaches students that if they feign helplessness, display apathy, or work slowly, the teacher will soon step in and complete the tasks. If kids instead learn to make appropriate levels of effort and to persist, they will build confidence in their ability to improve and learn. They'll realize that asking for help—not the answers—helps them learn. Letting students struggle constructively and safely in their teams enables each student to reflect on his or her thinking, compare it with others' ideas, and refine that thinking before sharing it with the class—or on a test.

4. Teach communication and problem-solving skills.

Setting up structures that promote effective cooperative learning is not enough. Team members need to know how to make good use of the opportunity to work with one another; this means they need to learn about, practice, and refine key interpersonal skills.[1]

Active listening. Active listening skills are essential in good group work—and in life. When students are listening well, their eyes are on the speaker and they occasionally nod. Active listeners avoid interrupting but periodically summarize what they hear and ask for clarification when needed. These practices communicate respect for the speaker and enable the listener to learn as much as possible from that speaker's words.

Explaining ideas and opinions. Team members need this skill to communicate and persuade in cooperative interactions. Explaining must go beyond single-word answers; students must be able to identify sources or reasons for their personal opinions or conclusions. They must explain their ideas to others so that peers can understand them too. This demands metacognition, evidentiary thinking, summarizing, paraphrasing, and listening to others thoughtfully.

Encouraging teammates. Effective team members know how to encourage and support teammates, disagree with dignity, and help maintain a positive, prosocial tone within the group. Tell students you expect them to make sure that all team members are actively participating in the thinking parts of the group's tasks. Teach them how to make that happen.

Explaining your own ideas while also encouraging others is a complex skill that demands that students respect one another. Guide kids to make teamwork time a safe environment in which to speak, receive feedback, and admit what they don't

understand. Once students establish a productive working relationship, they can set goals together, monitor their own progress, and solve learning problems together.

Completing tasks. Students should be expected to work on the group's tasks until they are finished to a high standard and to ensure that at the end of a team study session, all participants have learned the class objective.

When students know what constitutes great work within their team, and reach that standard, they can be proud of themselves and of any recognition their group receives.

5. Integrate cooperative learning with other structures.

Cooperative learning should be seen as a key part of each lesson, but not the whole lesson. Effective class lessons might also include teacher instruction, media- or computer-based activities, and individual assessments of various kinds. Informal cooperative-learning activities such as random reporter or think-pair-share may also be used, but these shouldn't be the only cooperative activity.

The best way to use cooperative learning is to replace individual work, which in traditional lesson cycles happens after lessons and before assessments. Individual, isolated practice is boring and ineffective for most students, especially if they struggle. Cooperative learning makes practicing to mastery engaging and social and gives all students "study buddies" to help them when they run into difficulties.

Sometimes team activities may come before teacher instruction, as when

teams are conducting experiments in a discovery learning format. But at some point, a teacher needs to explain the essential objectives and give students parameters and guidance for their group work so they can move forward.

Watching a Transformation

I once observed a class of 9th graders who started the school year reading significantly below grade level. Their first-year teacher worked hard to provide a research-based cooperative learning model in which they would read a wide variety of complex texts, discuss them in teams, and prepare one another to participate in class discussions. However, students weren't making the desired progress. As the teacher looked for what was missing, she noticed students were sloppy in their work and slow to complete tasks. Although they often talked to one another, they weren't helping one another.

The first change this educator made was holding each student individually accountable for the work. The second was providing and discussing with the class rubrics for high-quality answers or comments in discussions. Students and teachers practiced scoring sample answers and exchanged feedback.

Then she made the task more interesting, challenging, personal, and relevant. She asked students to read closely and compare several journal articles about the science of emotions. Team members were to help one another answer questions that required more than recitation of facts from the articles, but to individually form their own hypotheses about the author's intent in writing the articles—and support those hypotheses with evidence from the texts.

In a few days, when the students realized that the teacher wasn't going to dilute this work to save time, they dug into the articles. Discussions flourished. Well-structured cooperative learning and recognition of work that met the standards of the rubrics ultimately transformed this class from remedial to advanced. When the students were asked what they thought about how their class was changing, one girl summed it up: "When I work with my teammates and we use the rubrics and our brains, we *know* we have a good answer. We're proud to show what we know—we are ready for any of us to report out."

Used properly, cooperative learning is an exciting way for all kids to learn. Research finds that if teachers make the five elements discussed here part of group learning, students learn more, feel more successful, love school, and enjoy the subject they're studying—and like and accept one another (Roseth et al., 2008; Slavin, 2013; Webb, 2008). For outcomes like these, it's worth the effort. ■

[1]Information on Success for All's professional development and materials to help teachers impart cooperative-learning skills, including videos of what each skill looks like in practice, are available at www.successforall.org.

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Learning Targets

Susan M. Brookhart and Connie M. Moss

An 8th grade math teacher is introducing a lesson on exponents, and we're watching a video of her class. The purpose of her lesson, according to the material that accompanies the video, is for students to discover and then describe the rules for multiplying exponents. But you'd never know it from the lesson. The teacher defines exponents and illustrates exponential growth with cubes and then with a graph. Students get excited about this and begin to ask questions about exponential growth, only to be told that's not what their lesson is about today.

On the board, the teacher shows students how to multiply exponents and then tells them to begin work on a worksheet. By the time the students actually start doing their work, most of us watching the video feel misled. First we thought the students were going to learn about growth, and then we thought they were going to discover their own principles for multiplying exponents. When it's all said and done all they got to do was reproduce the teacher's logic on a worksheet.

This video is a great argument for the importance of learning targets. Teachers who watch it can see that students have a hard time figuring out what they're supposed to be learning and why. For example, one student

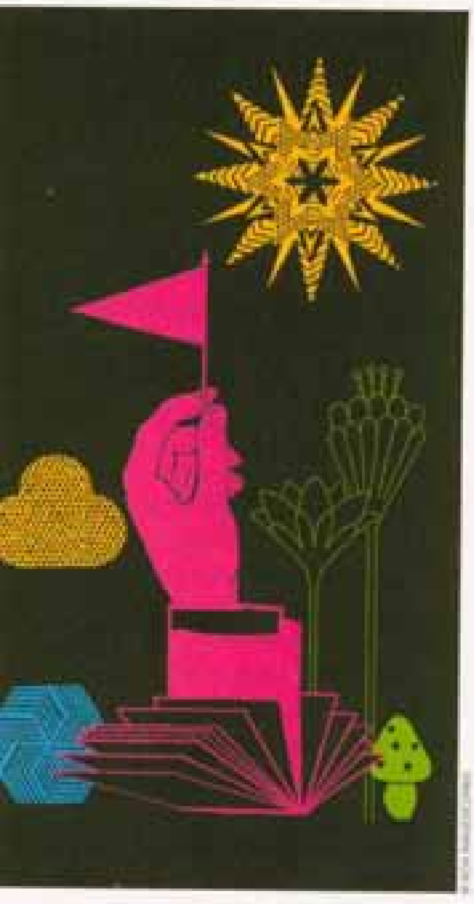
on Parade

When daily learning targets add up to larger learning goals, instruction sticks.

excitedly asks, "Oh, would that be a parabola?" and the teacher replies that they'll talk about that in a future lesson. (If you want to see for yourself, watch the first 10 minutes of the video at www.timssvideo.com/69.)

What the Research Says

Clear learning goals help students learn better (Seidel, Rimmele, & Prenzel, 2005). When students understand exactly what they're supposed to learn and what their work will look like when they learn it, they're better able to monitor and adjust their work, select effective strategies, and connect current work to prior learning (Black, Harrison, Lee, Marshall, & Wiliam, 2004; Moss, Brookhart, & Long, 2011). This point has been demonstrated for all age groups, from young children (Higgins, Harris, & Kuehn, 1994) through high school students (Ross & Starling, 2008); and in a variety of subjects—in writing (Andrade, Du, & Mycek, 2010); mathematics (Ross, Hogaboam-Gray, & Rolheiser, 2002); and social studies (Ross & Starling, 2008).



The important point here is that *students* should have clear goals. If the teacher is the only one who understands where learning should be headed, students are flying blind. In all the studies we just cited, students were taught the learning goals and criteria for success, and that's what made the difference.

It's not enough for a teacher to plan a learning target and tell students about it once. Writing a learning target on the board but not having students do anything with it during the lesson won't harness the learning energy these studies describe. This sort of lip service to learning targets is what Marshall and Drummond (2006) call conforming only to the "letter" and not the "spirit" of assessment for learning. A learning target theory of action calls for teachers to design the right target for the day's lesson and use it *along with their students* to aim for and assess understanding. Students have the learning target in mind as they do their work, and they filter what they do during a lesson by asking themselves how this activity or assignment will help them hit that target.

Having a learning goal for students means more than just having a great learning target for today's lesson. All the learning targets from a sequence of lessons must add up to a larger unit goal or state standard. It's also not enough to have only the larger goal. Students experience learning one lesson at a time, so they need to know what they're supposed to be learning during each lesson. Each daily learning target needs to add a subsequent level of challenge or increase students' understanding or skill from the previous lesson and prepare them for the lesson that follows.

What Are Learning Targets?

A learning target describes, in language students can understand, what students will learn in today's lesson. That description can be accomplished through words, pictures, demonstrations, or other experiences; it doesn't have to be in an "I can" statement. A learning target should

1. Describe for students exactly what they're going to learn by the end of the day's lesson.

2. Be in language students can understand.

3. Be stated from the point of view of a student who has yet to master the knowledge or skill that's the focus of the day's lesson.

4. Be embodied in a performance

of understanding—what the students will do, make, say, or write during the lesson—that translates the description into action. A performance of understanding shows students what the learning target looks like, helps them get there, and provides evidence of how well they're doing.

5. Include student *look fors* (sometimes called criteria for success) in terms that describe mastery of the learning target rather than in terms of a score or grade.

Learning targets should describe learning, not activities. If you find yourself describing an activity (*Students will write five sentences*), ask yourself, "What will the students learn by doing that?" (*I can write sentences that tell complete thoughts*).

Also, because teachers are so used to thinking in terms of unit goals or other "chunks" of the curriculum (learning long division, learning how to do persuasive writing, learning about photosynthesis), they sometimes repeat the same learning target day after day to give students more practice with the skill or concept. To plan a series of lessons in which *students* see where they're going and help you get them there, you need more than that.

Each day, students should know what new content they're learning and how they're sharpening their skills. Are they learning a new concept? Extending understanding by building on a previous concept? Combining concepts to form more sophisticated understandings? Practicing a skill for accuracy or fluency? Applying a skill they already know to new content? Clarifying the target helps students understand exactly what they're supposed to focus on, helps them monitor their learning, and—because autonomy and control are major motivators—makes learning and practice more engaging.

Each day, students should know what new content they're learning and how they're sharpening their skills.

Learning—Or Doing?

Let's start with a counterexample. One teacher we know started a unit on literary language with this goal: "Students will learn that point of view and figurative language help tell a story." In her mind, that became the learning target for *all* the lessons in the unit. So the daily learning targets she presented to students were statements like these: *The students will put examples of figurative language on cards and sort them according to type*, *The students will identify two examples of simile and two examples of metaphor in Jean Craighead George's* Julie of the Wolves, and so on.

This teacher had some good ideas for potential performances of understanding. The part she skipped was showing students what all this activity would help them learn so they'd see the purpose in the activities and know what to focus on. The *real* learning targets could be summarized like this:

- I can define simile and recognize examples in literature.
- I can define metaphor and recognize examples in literature.
- I can distinguish metaphors from similes.
- I can explain how metaphors and similes enhanced the storytelling.
- I can describe and identify examples of different points of view.
- I can explain how the point of view affected the story.

One or two such targets add concepts and skills in small increments each day.

There are several advantages to spelling out learning targets by describing what students are going to *learn* and then embodying them with plans for what students will *do*, rather than rolling them all into one. When students have learning targets articulated in this way, they can answer the question, "What are you trying to learn?" They begin to see learning as growing a body of knowledge and skills, rather than checking off a series of assignments.

As for the teachers, they begin to see the activities they select as samples from among all the other possible things students could do to learn today's lesson, rather than as the purpose for the lesson itself. This helps with all sorts of instructional moves, including differentiation for various learners' needs and extension of learning for those who can already do the day's activity.

What It *Should* Look Like

The two examples that follow show how a parade of learning targets builds a learning trajectory that leads students to a larger instructional goal. Moreover, they clarify the difference between what students will *learn* and what they will *do*.

In an Elementary Classroom

Ben Golab teaches 2nd grade at Lenape Elementary School in Ford City, Pennsylvania. His mathematics unit on subtracting with double digits consisted of a series of five lessons. The first lesson's learning target was, *I can subtract a one-digit number from a two-digit number without regrouping (borrowing), using cubes*. The performance of understanding included modeling subtraction problems of this type with math cubes.

The discussion and questioning focused on concepts of numbers and operations—for example, that no regrouping was needed because the cubes representing the top number were numerous enough to take away the number of cubes representing the bottom number. Mr. Golab also told his students how what they were doing with cubes today would lead to what they would do with pencil and paper tomorrow.

The learning target for Lesson 2 was, *I can subtract a one-digit number from a two-digit number without regrouping, without using cubes.*

Lesson 3's target was, *I can subtract a one-digit number from a two-digit number with regrouping, using cubes.* During this lesson, as for the others, the teacher circulated around the room and gave students feedback. He used strategic questioning to help students see that regrouping using cubes in subtraction worked in the opposite way from how they regrouped using cubes in addition, emphasizing mathematical reasoning. He said, "Remember for subtraction we start at the *top* of the problem to decide about regrouping, not at the bottom like we do for addition. Which number is bigger here, top or bottom? Do you need to regroup?"

For Lesson 3, the teacher focused especially on one of the criteria for success—*I use regrouping when the problem needs it, and I don't use regrouping if it doesn't.* When students

couldn't make this distinction, the teacher pulled them aside and worked with them on problems that didn't require regrouping until they were ready to move on to problems that required regrouping.

Lesson 4's learning target was, *I can subtract a one-digit number from a two-digit number with regrouping, without using cubes.* Again, students realized that they were building on their concrete learning from the previous lesson to learn how to subtract using paper and pencil. Most of them came to this realization on their own, because moving from Lesson 3 to 4 followed the same pattern they used to move from Lesson 1 to 2—from cubes to paper.

Lesson 5's learning target was, *I can subtract a two-digit number from a two-digit number with regrouping.* Students applied what they had learned about subtracting two-digit numbers that required regrouping in the ones place; they were just adding one more piece—subtracting in the tens place.

These learning targets moved students step-by-step from readiness—they already knew about one-digit subtraction and how to represent numbers with math cubes—to the larger learning goal of two-digit subtraction. This learning goal was the *destination* for the parade, not the learning target for each lesson. Each lesson took the students one step farther down the road.

In a Secondary Classroom

Joe Cali's 10th grade government class at Ford City High School in Pennsylvania was studying a unit on the federal bureaucracy. The teacher planned a series of eight lessons. In previous units, the students had examined the powers of the president of the United States and how they carry into the three branches of government. They had examined the checks and balances designed into that structure and their relationship with presidential power.

In this unit, students were going to learn how to categorize the federal bureaucracy into three subunits (the executive office of the president, the cabinet departments, and the independent agencies).

The teacher had three goals for the unit. Students would

- Have a better understanding of the complexity of the federal bureaucracy.
- Realize that the design of bureaucracy puts some agencies within the reach of partisan politics and some theoretically outside that reach, although still subject to some political pressure because they were created by either the president or Congress.

Learning Targets and Performances of Understanding for a 10th Grade Government Class

These lessons were part of a unit on the U.S. federal bureaucracy.

Lesson 1

Target: Students will learn the characteristics of a bureaucracy and three agencies or subunits of the federal government.

Performance of understanding: Students read and discuss scenarios (for example, a Gulf War veteran has a question about his or her benefits) and then determine which agency they would contact, explaining their reasoning.

Lesson 2

Target: Students will learn the makeup and responsibilities of the Executive Office of the President.

Performance of understanding: Students are given a chart of the three departments of the Executive Office of the President (the White House, National Security Council, and Office of Management and Budget); they fill in agency specifics, such as director/head, key members, purpose of the agency, and the agency's major activities.

Lesson 3

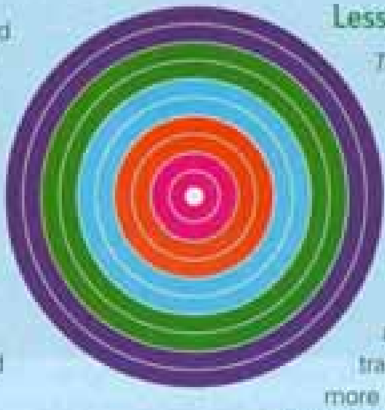
Target: Students will learn the makeup and responsibilities of the cabinet departments and their relationship to the Executive Office of the President.

Performance of understanding: Students answer four questions: (1) How are the executive departments organized? (2) What is the cabinet, and how are cabinet members organized? (3) What are the two main responsibilities of cabinet members? (4) What is the link between the cabinet departments and the Executive Office of the President?

Lesson 4

Target: Students will learn the makeup and responsibilities of three types of independent agencies.

Performance of understanding: Students make a chart with the three types of independent agencies, including defining characteristics and examples for each.



Lesson 5

Target: Students will learn how to analyze certain issues facing the United States and relate them to the appropriate type of independent agency.

Performance of understanding: Students are given four scenarios, and they determine which type of independent agency they would contact in each case. Then they search in the local phone book (or online) and find out where the local agencies for these services are located.

Lesson 6

Target: Students will compare and contrast private business management with the management of federal agencies.

Performance of understanding: Students are given the business management flow chart for Walmart or McDonalds and compare that to a similar flow chart for the U.S. presidency and cabinet. Students compare and contrast the charts and analyze where they see more effective management, with supporting written arguments.

Lesson 7

Target: Students will extend those ideas by evaluating whether bureaucracy is the most effective way to organize and manage government functions.

Performance of understanding: Students write a five-paragraph essay that answers the question, Is federal bureaucracy essential to good government?

Lesson 8

Target: Students will learn that various taxes are levied to fund various parts of the federal bureaucracy.

Performance of understanding: Students make a chart that lists three types of taxes (individual income, corporate income, and social insurance), with a detailed description of each, including whether the tax is progressive or regressive.

■ Be able to identify the various workers' roles and the budget involved in each type of agency and, by doing so, come to a better understanding of where federal taxes go.

In the next unit, the students were going to study federal taxes.

Mr. Cali didn't use "I can" statements for his learning targets. Rather, he focused on a clear definition of the content that he coordinated with performances of understanding, activities that the students engaged in for each lesson that translated the content into action (see "Learning Targets and Performances of Understanding for a 10th Grade Government Class").

This parade of lessons and learning targets led to the larger goals of understanding the federal bureaucracy and the various agencies' relationships with politics and taxes.

One way Mr. Cali kept the lessons coherent and unified was to continually explain how each lesson fit into the bigger picture. For example, he pointed out how students' previous learning about the powers of the president and Congress was part of the background they needed to understand why different federal agencies were created, how their learning about the responsibilities of the different agencies was part of the background they needed to understand the agencies' funding requirements, and how their learning about funding requirements would be part of the background they would need to understand federal taxes in the next unit.

Notice, too, that some of the daily learning targets called on students' reasoning skills to put some of these pieces together themselves. Using learning targets in these ways, in lesson-sized steps, helped students reach a larger understanding of the federal bureaucracy.

More Than Fanfare

Every lesson needs its own reason to live. One of those reasons is that today's lesson builds on the learning from yesterday's lesson and leads to the learning in tomorrow's lesson so that the learning targets form a parade that leads to the achievement of larger curricular goals and state standards.

Students should never feel as though they're simply repeating the same thing today that they did yesterday.

Some authors call those larger goals learning targets, too. We prefer to save the term *learning target* for individual lessons, for two reasons. One, using *target* for the lesson-sized learning goals and *goals* or *standards* for the larger learning goals avoids the confusion that comes with calling two different things by the same name. Two, having a special name for the lesson-sized learning goal emphasizes the idea that every lesson needs one. Students should never feel as though they're simply repeating the same thing today that they did yesterday.

When the learning target for today's lesson builds on yesterday's learning and leads to tomorrow's learning, and when all the learning targets in a sequence of lessons lead students to achieve a curricular goal or standard, learning will stick. ■

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Content-Rich Instruction in Preschool

Universal preschool has the potential to close the knowledge gap—but only if we consider how to best teach preschoolers.

Susan B. Neuman

Stakes were low but passions were high as 4-year-olds discovered whale blubber and learned about marine mammals in a preschool classroom I recently visited.

"That's gooey," Tony cried, placing his hands in blubber-lined mittens.

"This is what the animal uses to keep warm and survive the cold water temperatures," Tony's teacher explained. Whipping out detailed pictures, she added, "Blubber acts as an *insulator*. It holds in the warm-blooded mammals' body heat, even when they are swimming in water as cold as 40 degrees."

Stakes may have been low in this marine mammal exploration, but they're high in terms of the public's expectations of preschools. Political leaders are gambling that early education will close

the achievement gap between children of wealthy and poor families. Some are promising universal prekindergarten. In his 2014 State of the Union address, President Obama renewed his pitch to boost annual prekindergarten spending by $7.5 billion. New York Mayor Bill de Blasio and Governor Andrew Cuomo each revealed a plan to extend preschool to all young children in their jurisdiction. With Cuomo's support, de Blasio is currently on track to increase the number of full-day preK programs in New York City from 20,000 to 53,000 by fall 2014. Leaders in Michigan, California, Florida, and other states have unveiled plans to subsidize preschool.

But unbridled enthusiasm for universal preschool must be balanced with thoughtful consideration of what goes on in these classrooms—and what activities will most support children's learning. I've observed an extraordinary amount of time devoted to mindless instruction in prekindergarten settings.

Thematic instruction in preschool **must have coherence and depth** to help kids understand a topic well.

In 2010, my colleagues and I observed morning meeting time in 55 preschool classrooms to examine the kinds of activities that took place and the opportunities afforded for content-rich instruction (Neuman, Kaefer, & Pinkham, 2010). We recorded an average of 20 minutes or more each day devoted to morning meeting. Here's how the time was used in too many classrooms: Children memorized lines of print, said the alphabet and the numbers 1–10 five times, spelled their names, spelled names of children who weren't there, and read along with the teacher in a highly predictable format. We saw no effort in these meeting times to engage children's minds through stimulating content learning while teaching literacy (Neuman & Pinkham, 2014). Further, we saw strikingly few opportunities for cognitively engaging talk. Such approaches are unlikely to make progress in closing gaps.

What Content-Rich Looks Like

Content-centered classrooms, in contrast, involve preschool children in learning about print through literacy practice (Neuman & Wright, 2013). Preschoolers enhance their content learning while developing the skills and functions of literacy. Their new abilities become meaningful because they help these children understand their world.

This approach builds on five research-based principles about how young children develop the schemas necessary to construct basic knowledge networks.

1 *Learning benefits from integrated instruction.*
Whether they assign multidisciplinary projects or teach through themes, effective teachers use integrated learning to organize large amounts of content into meaningful concepts. Both projects and themes help children build knowledge networks and provide time for repeated practice of familiar concepts like grouping items into sets. When children apply skills in multiple contexts, their learning will likely transfer to new areas.

Thematic instruction must have coherence and depth if it is to help kids understand a topic well. Cafeteria-style approaches that involve teaching a little of this and a little of that give only spotty attention to content and make limited connections between subjects.

2 *Learning requires guidance.*
Effective teachers actively engage young children in mastering content, helping them connect new learning to what they already know and can do. Consequently, in instructional planning, they strike a balance between structure and choice.

Sometimes, teachers present a concept in a planned and directed way to ensure that kids understand the new knowledge thoroughly. Other times, they let kids explore, manipulate, and use ideas in centers of their choosing. Both ways of learning are necessary for young children's cognitive development.

3 *Teacher interaction enhances learning.*
Teachers hold great influence over whether preschoolers reach their potential. Working on the edge of students' current competence, they involve kids in experiences that are slightly more difficult than those they could master on their own. Teachers carefully scaffold students' learning, gradually decreasing the amount of assistance they proffer as students become able to perform tasks independently. They encourage students to express their ideas through language and to raise questions that enable them to develop more complex ideas and understandings.

For example, after reading aloud an informational text about animals and their life cycles, a teacher says, "Let's think about the need for food. How is a baby animal's need for food different from a parent animal's need for food?"

A range of teaching strategies can be the platform for great teacher-student interaction. Demonstrating skills shows young children the standards of good practice; explicit instruction, questioning, and ongoing feedback help them expand their own ideas and skills.

4 *Play supports learning.*
Free exploration and manipulating objects, make-believe play, and creative games make important contributions to preschoolers' literacy development (Neuman, Roskos, Wright, & Lenhart, 2007). In play, children express and represent their ideas, learn to interact with others, and practice newly acquired abilities and knowledge. Teachers who build background knowledge and who make key concepts "stick" with children realize this. They provide conditions and materials that positively affect what activities children choose during playtime and how they play. They construct play environments that involve literacy in practice.

For example, after a class reads about insects, the teacher might place an ant farm in the discovery play center, along with a magnifying glass, lab coat, and notebook for recording activities related to the ants' adventures. Children will delight in acting like scientists, describing the foods the ants eat and the patterns their movements take.

Gap-closing teachers seek to enhance language and play while leaving children in some control of their activities. At times, teachers actively engage children in role-playing related to background content, like the activities characteristic of certain jobs or life roles. A teacher might model a role like grocery store manager or chef. As children imitate these roles and expand on them in free play, related concepts and vocabulary will be integrated into their developing language repertoire.

> Unbridled **enthusiasm for universal preschool must be balanced by thoughtful consideration** of what goes on in these classrooms.

5 *Competence enhances motivation.* Self-esteem grows when children begin to develop a history of achievement through reasonable effort. Effective teachers recognize that experiences and practices that help preschool students become skillful and learn many things are more effective than those designed to *just* be motivating. Students thrive with teachers who combine nurturance with high expectations.

A Day in a Classroom

What does a preschool classroom that enriches content knowledge as it builds literacy look like? Here's a typical day in a preschool class I observed that provides such enrichment to the 18 4-year-olds in the class. This preschool is part of Michigan's Great Start Readiness Program, a statewide initiative for at-risk preschoolers.

Students arrive between 8:30 and 8:45 a.m. The teacher, Ms. Allen, greets them at the door. They hang their coats in individual cubbies labeled with their names and photos, then "check in" by finding their name on the attendance chart and making a mark by it. Some visit the library corner or dramatic play center as they wait for others to arrive.

Around 8:45, Ms. Allen sings a song to indicate that morning meeting will begin, and the children gather in a circle. After a greeting, she describes some of the new choices for the upcoming activity time and demonstrates how particular pieces of equipment can be used. Children show their activity choices by raising their hands before being dismissed. Because more students want to go to certain centers than can be accommodated, Ms. Allen shows how they might cooperate.

Ms. Allen has planned all activities in the centers to expose students to concepts and thinking related to *sound*. In one area, children make popcorn with adult supervision. They hear the sounds of popping, smacking corn and notice when these sounds taper off. Kids send marbles clattering down various chutes in the block area; and in the science area, they use resonating bells and voice recordings to hear different pitches. Other learners listen to a tape of natural sounds and draw pictures of what they hear. Ms. Allen plays a rhyming-word matching game with a group of children who she has detected need special attention with this phonological skill. The paraprofessional in her classroom moves from group to group, monitoring children's progress.

Once activity time is over, the children gather to share about the morning's activities. They review the sounds they've heard and talk about how sounds are made, writing the new vocabulary that comes up on a word chart that they'll add to throughout this sound unit.

Music helps strengthen the children's phonological awareness (Neuman, Roskos, Wright, & Lenhart, 2007). Ms. Allen introduces songs with distinctive rhythms and sounds, like "Oats and Beans and Barley Grow," and the children take turns clapping out a rhythm. She introduces a slightly more difficult rhythm and encourages them to follow her lead. The group sings "Willoughby Wallaby Woo" to sensitize them to similar sounds at the beginning and end of words.

Ms. Allen selects two children to help put out snacks, pronouncing their names slowly, emphasizing the beginning sounds. She holds up a menu—words along with pictures—of today's snack: five graham crackers and one cup of juice.

The class next goes outside for an environmental sound walk. Children learn to identify objects and actions—the wind, other kids on the playground, squirrels rustling—by their sounds. Upon returning to the classroom, they recall some of the sounds they heard and write words for them on their chart. At story time, the teacher reads from one of her favorite anthologies of poetry and a delightful story about tolerance and sound by Bruce Bottner, following each with a short discussion.

Ms. Allen will follow up on this learning the next day. On her plan is reviewing different sounds the class heard, categorizing them as loud or soft.

A Closer Look

The arrangement of learning experiences in this class was sensitive not only to what preschoolers should know and be able to do, but also to children's need to explore new ideas on their own. Activities were well paced to provide sufficient variation and challenge. The schedule allowed for both teacher-directed instruction, such as during group time and story time, and choice, such as children's considerable opportunity to select their work during activity time. Ms. Allen provided guidance and direction through the materials she had organized in centers and her interactions with students. Arrival and dismissal were relatively short to allow more time for learning.

Stakes are high in terms of the public's expectations of preschools.

Children were very active throughout the day, mentally and physically. Everything they did focused on sound. Group time and activities were designed to extend their understandings through exploratory group activities, stories, materials to manipulate, and social interactions. All activities emphasized language.

Sound was a good topic for this content-rich learning. It was broad and varied enough to address a number of science guidelines (content and process) and to lead children to sharpen their oral language, print awareness, and phonological awareness. As they progressed through this unit, children had opportunities to learn more about sound through listening, fine arts activities, and writing.

This example highlights essential features of a content-rich classroom. Students were exposed to

- Time, materials, and resources to actively build linguistic and conceptual knowledge in a rich domain.
- A wide variety of reading and writing materials.
- Different grouping patterns (large, small, individual) and different levels of guidance to meet the needs of individual children.
- Opportunities for sustained, in-depth learning.

Classrooms like this help children build knowledge networks that enhance their foundational knowledge in core subject areas—knowledge that acts as a catalyst for kids to acquire more knowledge. In content-rich settings, early literacy skills support children's developing thirst for learning. Such classrooms have the potential to close the knowledge gap. ■

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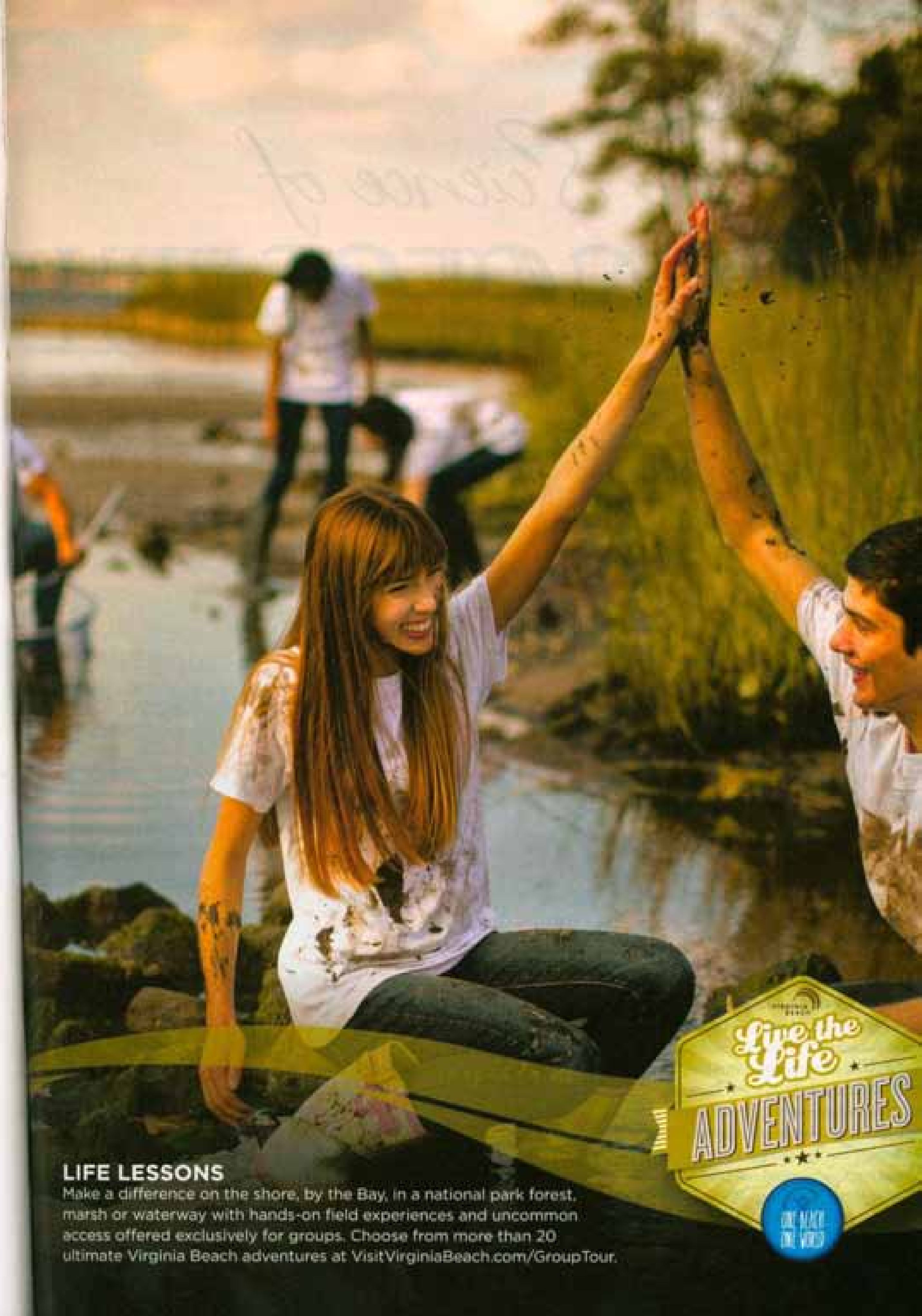
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The Science of SUCCESSFUL

When teachers introduce "desirable difficulties" into the learning process—such as frequent quizzing—students really learn.

Henry L. Roediger III

Many teachers share a belief that we should make learning as easy as possible for students. We want students to "get it" and not struggle. Educators often favor techniques that show quick benefits, ones that make learning happen fast.

For example, when students tackle problems in math—say, learning to solve for the volume of a solid—they often practice many examples of the same type. Sure enough, they quickly get the hang of it. They repeatedly apply the same formula, learn quickly, and feel a sense of accomplishment—and so do their teachers.

This process seems great, but there's just one problem: This kind of instructional strategy has repeatedly been shown to create ephemeral learning and leads to rapid forgetting. It's good in the short term but bad in the long

LEARNING

term. And that's hard for both teachers and students to realize.

Make It (Desirably) Difficult

Choose Mixed Practice over Blocked Practice

Blocked practice, in which problems of the same type are blocked together, is commonly used in education, industry, the military, and sports because it produces fast learning and students (and teachers) like it. After all, who *wouldn't* want to learn fast?

Yet the fact is, virtually every study comparing blocked practice to the alternative—mixing up examples of different types of problems after some initial instruction in each—shows that mixed practice is better on measures of long-term learning (Bjork, Dunlosky, & Kornell, 2013; Rohrer & Taylor, 2007). Why? Because certain difficulties encountered in learning—ones that can be overcome through effort—often produce better performance in the long term.

If students have to solve four different types of math problems, with the types given in a random sequence, the task feels hard and clunky to them because they're confused early on. With mixed practice of examples, students have to figure out what kind of problem they're facing, then remember (or look up) the formula for it, and then solve the problem. Blocked practice is much easier because it avoids the first two steps—discovering the type of problem and determining the formula needed. In blocked practice, students just repeatedly run through the same routine.

Students—and their teachers—may struggle in mixed practice of examples during learning because the learning is slower and more effortful. Students may also be more easily discouraged early on by their apparent lack of mastery. However, deliberately making the process more challenging by mixing up the examples can actually help student learning.

Psychologists have coined a term to capture this idea—*desirable difficulties*. This idea may seem counterintuitive because we usually want to avoid difficulties. Of course, not all types of difficulties are good for long-term learning, but mixed practice offers desirable ones. In mixed practice, the challenging process of discovering how to identify a problem is already built in (Rohrer, 2009). If students slow down, consider what type of problem is represented, and perhaps consult their teacher or textbook, they can often overcome the challenge. The learning that results is deeper,

> Virtually every study comparing blocked practice to mixed practice shows that **mixed practice is better on measures of long-term learning**

more durable, and more flexible—just what we want our students to take away from our instruction.

Comparing blocked and mixed practice may help explain a common problem that math teachers often face: Students show great competence on problems in class and on homework but then muff the exam. The exam, of course, covers many types of problems, not just one. Students often do poorly on the test because they've been taught with blocked practice, so they have little experience with the more complex skill of distinguishing among problems.

Choose Active Retrieval over Rereading

Suppose students read a passage they'll be tested on a week later. Just after reading it, one group of students is given a test—they're told to recall as much of the passage as they can. The other group is given a more passive strategy—to simply reread the entire passage (Roediger & Karpicke, 2006). Of course, the first group will not be able to recall everything, whereas the rereading group will be exposed to all the material. In terms of reexposure, the students in the recall group are at a disadvantage.

What happens later? If students are tested immediately after the manipulation, the students in the group that reread the material in its entirety recall the passage better than the students who read it only once and reviewed it using a test. This shows that cramming (repeated reading) works, at least for the short term. However, if the same experiment is conducted but the test is delayed a week, those who read the passage only once but tested themselves recalled more than those who read the material twice.

That outcome is a complete reversal from what happened when those students were tested immediately. This second outcome, the one found after a delay, is called the *retrieval practice effect* or the *testing effect*: If students review material by actively retrieving it, they'll remember it much better over the long term than if they just passively read the material (Roediger & Karpicke, 2006).

Quizzing students on material (as opposed to having them reread it) thus represents another desirable difficulty. Doing the hard work of reviewing material by actively retrieving it leads to much better retention later on, even when students can't retrieve everything on the first test. Testing leads to other benefits, too. Students find out what they know and what they need to study more (Roediger, Putman, & Smith, 2011).

In research my colleagues and I conducted at a middle and high school in Columbia, Illinois, we found that students who experienced active retrieval practice through quizzing with student response systems had better grades on their exams than students who didn't have the extra quizzing or who had the opportunity to reread the material that other students were quizzed on (McDaniel, Agarwal, Huelser, McDermott, & Roediger, 2011; McDermott, Agarwal, D'Antonio, Roediger, & McDaniel, 2014; Roediger, Agarwal, McDaniel, & McDermott, 2011). Active retrieval seems to help strengthen pathways that will aid later retrieval; it permits students to subsequently use information, which is what we hope they'll do outside the classroom.

Much of education seems to be about getting information into the mind—to store it. That's a necessary condition for us to use the information later, but it's not a sufficient one. We also need to be able to access information when we need it, to pull it out. Retrieval practice helps us keep information at our mental fingertips.

Doing the hard work of reviewing material by actively retrieving it **leads to much better retention** later on.

Old Habits Die Hard

Research shows that methods like blocked practice or rereading work fine if performance is only measured shortly after learning (Karpicke, 2012; Karpicke, Butler, & Roediger, 2009; Kornell & Bjork, 2007). That's why we're fooled so easily. Teachers can look at quiz performance soon after teaching with blocked practice examples, see good grades, and think, "My students are really learning!" Yes, for the short term, but will they know the material on the final exam?

Similarly, students can repeatedly read their textbook or notes and then ace a test the next day and think they've really learned the content. But they may wonder why their knowledge has melted away by final exam time or, worse yet, when they need to know the material outside of class.

Nevertheless, most students still prefer to use blocked practice, and surveys have shown that even college students prefer to study for tests by rereading rather than by using a more active strategy like self-testing (Karpicke, Butler, & Roediger, 2009). Moreover, even when students experienced the benefits of these approaches in experimental settings, when asked how they would like to learn subsequent material, most still picked blocked practice over mixed practice and rereading over retrieval practice (Karpicke, 2012; Kornell & Bjork, 2007).

And it's not just students who hold such illusions. So do their teachers. And so did I—until I found a better way.

More Than a Four-Letter Word

I used to teach the way most college professors do, thinking that my lectures were precious and that tests were mostly for assigning grades to students and making sure they did the reading. I never thought of giving tests or quizzes *as a way to teach*. It took my own research to show me how misguided this impulse is, how giving tests can be crucial to learning.

In light of all the controversies over standardized testing and teaching to the test, *test* is clearly a four-letter word to most educators. But there's a better way to think of tests, which my colleagues and I call *retrieval-enhanced learning* (Brown, Roediger, & McDaniel, 2014). Standardized tests have their place in education, but our use of testing is completely different. We advocate frequent low-stakes quizzing or testing to enhance the process of learning. Students' self-testing (for example, through flash cards) is also a good way to learn.

Retrieval practice by way of testing really works (Karpicke, 2012). When teachers introduce desirable difficulties into the learning process, students learn. Preparing for tests is hard work for students, but they learn both from preparing for them and from taking them (especially when they are given feedback on their answers).

The problem is that the benefits of testing are not immediately obvious because retrieval practice facilitates long-term use of knowledge. Further, retrieval practice doesn't enhance knowledge just of basic facts but also of procedures, visual representations, and narratives. Some evidence also shows that retrieval practice may enhance transfer of knowledge to new situations (Butler, 2009).

I've changed my approach because of my and others' research on testing. I now require some sort of written assignment in every class period for every class I teach. In some cases, students take a quiz. For higher-level courses, students write a one- or two-page essay on some aspect of their reading assignment. These assignments require students to grapple with the material daily, not just coast along until the big test. The assignments or quizzes also make them write and, with luck, think hard about the material (at least harder than they would have without the assignment).

In some courses, I've given students sets of essay questions that might appear on the test; if they use these as a study guide and then practice retrieving answers to those questions, they'll do well on the tests. I also suggest methods for students to study effectively: outlining material (putting it in their own words); relating the material to material they already know and to examples from outside the classroom; and composing questions as they read the material as well as using their own questions for retrieval practice before the test. In my classes, the daily quizzes or essays count for a small part of students' grades (hence the adjective *low-stakes* before quizzes). Because students know they'll have a quiz or other assignment, I never give them surprise quizzes. They know to prepare every day.

Another problem we see in college is student attendance. Having a daily graded assignment in class makes attendance mandatory for a good grade. Further, if the teacher concentrates on important material on the quizzes in class, students will learn it better through retrieval practice.

I still give larger, hour-long tests in addition to the shorter quizzes as well as a cumulative final exam, and these count for the bulk of the grade. The quizzes are low-stakes events to keep students on target throughout the semester. Of course, I have more grading to do, but it's worth it for the improvement in student learning.

Embrace the Difficulty

When I describe research on the benefits of introducing difficulties, such as frequent testing, into the learning process, teachers often tell me "my students will rebel" or "my student ratings will suffer." But my experience, and that of my colleagues, says otherwise.

Because we teach at the college level, our students can often vote with their feet; they can take an easier section of the course or a different course entirely. However, they typically haven't done so. Once we explain our reasons for frequent quizzing, they accept them well. Many students say that when courses are taught this way, they're always caught up with their work and preparing for big tests or the final exam is easier.

Further, in our research using frequent quizzing in middle school classes, the majority of students report that daily quizzing makes them *less* anxious about taking tests. (We had originally received criticism that constant testing would make students more anxious.) The quizzes in our research are "zero stakes," in that they have no effect on students' grades, so students often look at them as a kind of game. And the students always get immediate feedback in the form of the correct answer.

The middle school students also point out that taking quizzes every day helps break up the class. The quiz takes only five minutes or so, but that's enough for a change of pace. Further, they're practicing what they'll need to do when they take the "real" test later. Thus, their reported level of anxiety about tests is often lower than it used to be (Agarwal, D'Antonio, Roediger, McDermott, & McDaniel, in press). Once they understand the reasons for the practice, students don't seem to mind daily quizzing or other techniques of active retrieval, such as responding in writing to questions based on their reading.

Will students find you harder as a teacher if you adopt practices that embrace difficulties and foster long-lasting learning? Possibly. However, I often ask my undergraduate students to tell me about their favorite teachers in middle school and high school, the ones who set them on their path to college. They're happy to do so, and everyone has a story. Somewhere in the conversation, I ask where their favorite teachers fall on the ubiquitous "easy to hard" continuum that students use for teachers. I typically find that students describe their favorite teachers as "demanding," "rigorous," or "tough but fair." Other comments included, "she made me think hard and discover what I could do" or "I never thought I could understand physics, but he led me through it and showed me the way."

Retrieval practice helps keep information at our mental fingertips.

So don't worry about embracing desirable difficulties in your classes, even if your classes are perceived as somewhat harder than they used to be. Your students will profit, and they'll thank you in later years when they still know the material you taught them. ■

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THE QUEST FOR *Mastery*

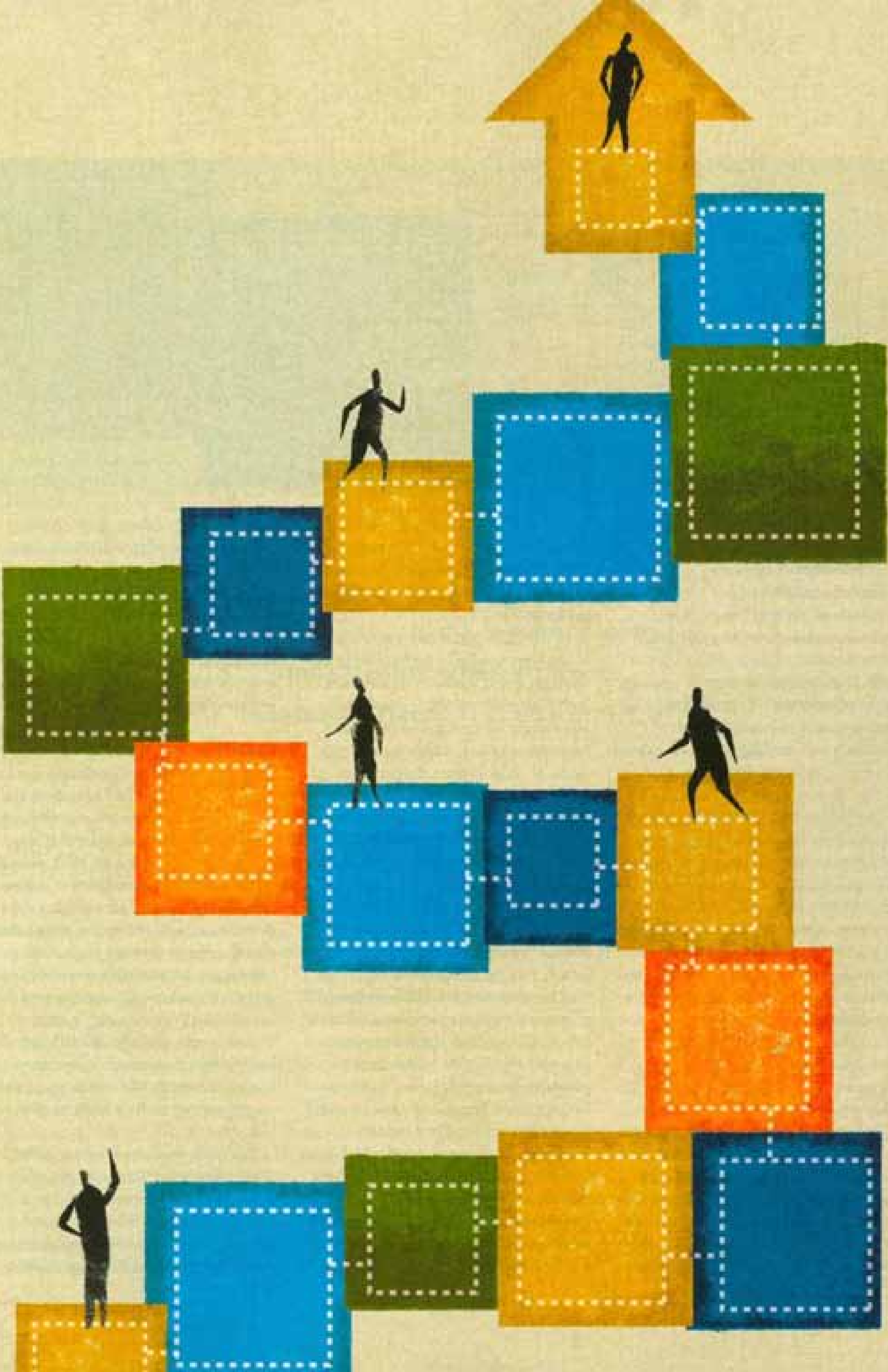
What practices do high-performing urban schools have in common?

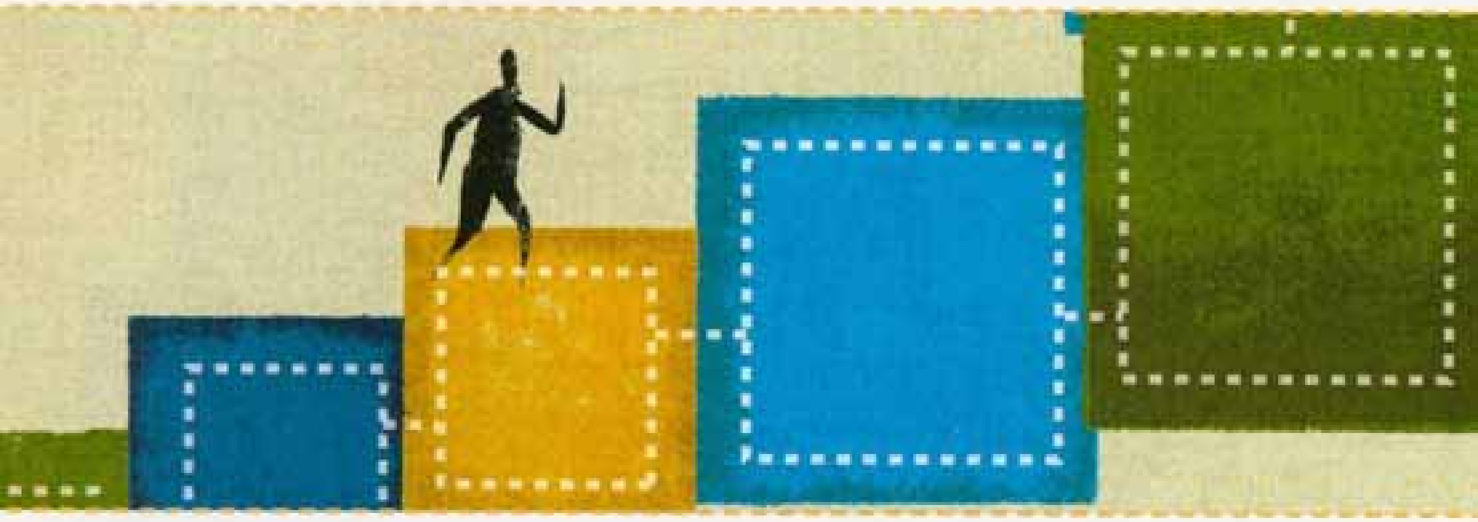
Joseph F. Johnson Jr., Cynthia L. Uline, and Lynne G. Perez

What drives decisions about what gets taught, how, and to whom? In some districts, teachers base these decisions on the organization of textbooks, the timing of pacing charts, or lesson plans from prior years. Often, they base curricular decisions on content that needs to be "covered." In contrast, in many of the United States' highest-performing urban schools that we have observed, teachers are making textbooks, workbooks, curriculum guides, and pacing charts secondary considerations. Their purpose is to teach in a way that is driven primarily by a commitment to ensuring that all students master agreed-on essentials. This distinction is not merely philosophical or theoretical. It is grounded in everyday practices.

Since 2005, the National Center for Urban School Transformation has identified and studied more than 90 urban schools that achieve impressive results. (See criteria at http://ncust.org/wp/awards/criteria.) These elementary, middle, and high schools do not use selective admission criteria, yet their achievement results exceed state averages. These schools boast high levels of achievement for every demographic of students they serve, including English language learners.

We have identified specific practices that characterize teaching in these schools (Johnson, Perez, & Uline, 2012). Many of these practices relate to the quest for mastery in everyday instruction. In particular, this means (1) educators plan lessons so that all students are likely to achieve a depth of understanding about a specific concept or idea and (2) educators are objective-driven as they strive to help every student achieve mastery.





Planning for Depth of Understanding

What It Is and Isn't

This type of planning aims to get students to demonstrate a thorough understanding of a set of concepts or skills. For example, a team of teachers might plan lesson activities that guide their students to explain accurately why each step in the process of solving a linear equation makes sense.

This type of planning is *not* getting students to demonstrate mere surface-level understandings, such as when a teacher focuses on having students follow the steps for determining the value of x in a linear equation. In activities that guide students to deeper understanding, students will not just complete the steps and solve the equation; they will explain each step and the logic associated with it.

How It Looks in Classrooms

When we observed classrooms, we asked students, "What did you learn in this lesson?" In typical schools, we frequently heard one- or two-word answers that named the lesson topic, like "polyhedrons," "the American Revolution" or "osmosis." Even when we probed, students tended to recite one-line facts, such as "The colonists fought the British" or "You multiply the base times the height," leaving us wondering what students really understood.

In the high-performing urban schools we studied, teachers were not satisfied when students memorized facts, recited formulas, completed algorithms, or performed other rote functions. Teachers also wanted students to demonstrate deeper levels of understanding by explaining concepts, describing relationships, evaluating arguments, analyzing perspectives, and performing other tasks that required complex thinking.

For example, at Horace Mann Dual Language Magnet School in Wichita, Kansas, 5th graders exiting a science lesson (taught in Spanish) explained that they learned about the forces that work together to make a volcano erupt. They talked about the massive pressure that builds as the earth's plates shift. They eagerly described how gases, magma, and rock escaping from the earth's surface caused different kinds of eruptions. The students had learned more than a few random facts. They had learned important concepts that would be useful as they developed understanding of other scientific phenomena.

The pursuit of this depth of understanding takes time. But teachers at many of these schools perceived that they had more time because they were not trying to cover as many standards and objectives. Also, teachers frequently commented that they spent less time reviewing and reteaching.

How It Looks in Planning Meetings

Teachers in the high-performing urban schools we studied served students with diverse academic abilities, varying social and emotional needs, and an array of language backgrounds. These teachers believed their students were able to master challenging academic standards; however, they knew that they must provide outstanding instruction to ensure that mastery was achieved. Thus, the journey toward mastery was meticulously planned. Teachers worked together in grade-level teams, departments, or course-specific teams to plan instruction that was likely to result in high rates of mastery.

For these teachers, regular collaborative planning was an engine that drove the quest for mastery. Their clear agendas and training in conducting effective professional learning communities helped maximize the benefit of collaboration. Planning was not a joint search for useful worksheet pages, interesting video segments, or fun activities related to the lesson topic. Instead, it was an intense, deliberate, cooperative process for defining content, materials, and methods that were most likely to lead all students to mastery. Recognizing that they often had only a few days to get students to understand a complicated concept, teachers worked together to make each minute count. Planning produced a detailed road map, charting a path from current levels of understanding to desired levels of mastery (Wiggins & McTighe, 2005).

During their meetings, teachers in the high-performing schools determined what level of understanding they wanted students to achieve. They also pushed themselves to specify what they would accept as evidence that their students had achieved that deep understanding. Teachers at Highland Elementary in Montgomery County, Maryland, decided, for example, that in a lesson on making inferences, they would not only have their primary-grade students make inferences about a passage, but also have them evaluate the quality of their inferences on the basis of information found in the text. Thus, students would be demonstrating their ability both to make inferences and to analyze how clearly a passage supported the inferences they made.

During collaboration meetings at Magnet Traditional School in the Phoenix Elementary School District in Arizona, teachers asked themselves questions like these:

- What specific objectives must students achieve to master this standard?
- What words must become part of the students' vocabulary if they are to discuss this concept comfortably?
- What misconceptions are likely, and what can we do to prevent or minimize these misconceptions?
- How can we present this concept so that students see how it connects with their backgrounds and prior knowledge?

Such questions shaped collaboration meetings in many high-performing urban schools. Teachers used these questions to design powerful lessons that were more likely to ensure students mastered each objective taught.

In the high-performing urban schools we studied, **teachers were not satisfied when students memorized facts**, recited formulas, completed algorithms, or performed other rote functions.

Objective-Driven Lessons

What It Is and Isn't

Every aspect of an objective-driven lesson is designed to lead all students toward mastery of the lesson objective. These lessons go beyond displaying an objective as an act of compliance or routine. Posting on the board that "students will be able to describe the relationship between the earth's revolution around the sun and the four seasons" and having students read a textbook chapter on seasons and answer the five questions at the end is *not* objective-driven instruction.

An objective-driven version of this lesson might require teachers to create strategies to help students describe the relationship between the earth's revolution around the sun and the four seasons. The teachers could identify activities that will help students use key vocabulary words, such as *axis*, *equator*, and *revolution*. Students might model the relationship between the sun and the earth during different seasons, first for their state and then for various other locations, such as Alaska, Ecuador, Kenya, and Antarctica. As they implement the lesson, teachers would monitor whether students were engaged and take note of what students appeared to understand and not understand. They would then respond with additional examples or models.

How It Looks in Classrooms

In the high-performing urban schools we studied, objectives were specific destinations to which teachers promised they would take their students. In typical schools, some teachers state an objective as an indicator of what they will cover, such as "photosynthesis," "pages 128–130," or "English Standard 3: Compare and Contrast." In contrast, the teachers in high-performing urban schools specified precisely what students would be expected to understand or demonstrate before the lesson ended.

For example, at MacArthur High School in Aldine Independent School District in Houston, Texas, teachers posted three-part objectives that specified (1) what students would learn, (2) how they would learn it, and (3) how they would know they learned it. The objective influenced every aspect of the lesson—how teachers introduced concepts, how they engaged students in activities, which materials they used, how they integrated technology, what vocabulary they emphasized, what questions they asked, and what they asked students to demonstrate.

For example, an algebra lesson might have focused on an objective specifying that students would be able to use a real data set that represented a linear equation to make predictions about a variable. Students would learn by graphing the linear equation (by hand and using the graphing calculator) and by using an algorithm to determine the value of one of the variables. Students would know they had achieved mastery if their hand-drawn graph, the calculator-generated graph, and their linear equation all yielded the same accurate information that the student could describe clearly.

At another Texas school, Eastwood Middle School in El Paso's Ysleta Independent School District, teachers tailored their lessons to increase the likelihood that students would master the objective, not according to the order of lessons in a textbook, their file of worksheet pages, the favorite unit from years past, or the availability of a fun piece of software.

One lesson objective focused on helping students conceptualize strategies for calculating negative space in round objects. To help their 8th grade students relate to the concept, teachers brought clear canisters of tennis balls to class and helped students determine the volume of space in the cylindrical canister. Then they engaged students in considering strategies for determining the volume of space left after the tennis balls were placed in the cylinder.

Objectives were specific destinations to which teachers promised they would take their students.

We found teachers using a wide array of strategies to engage all students—including students who were behind academically, students with behavioral and emotional challenges, students who were shy and reluctant to engage, and students who were English learners. Teachers frequently challenged students to explain their thinking and share their ideas. Instead of calling on students who raised their hands, teachers tried to ensure that every student participated by having students write responses on individual whiteboards, organizing short small-group conversations, calling on students randomly; using electronic polling, or engaging students in Socratic seminars. Fisher and Frey (2007) describe a similar array of strategies for checking each student's levels of understanding.

Being objective-driven means not allowing students to sit passively and fail. At Kearney School of International Business in California's San Diego Unified School District, students were required to engage actively, contribute to group tasks, and participate in discussions. One transfer student, in his previous school, had become accustomed to sitting quietly in class with his head on his desk and his hood over his head. When the Kearney principal pulled the student out of class, the student protested, "What? I wasn't doing nothing!" The principal explained, "You're right. You weren't doing anything, and that's not acceptable here." At Kearney, teachers did not ignore disengaged students. Instead, they pushed those students to participate actively.

When students participated, teachers in these high-performing schools observed closely, monitored student understanding, and adjusted instruction accordingly. Often, teachers tried to adapt their presentation of a concept to better connect it to students' interests, backgrounds, learning styles, prior experiences, or culture.

How It Looks in Planning Meetings

Teachers realized that student participation might not be sufficient to generate mastery if the participation did not promote meaningful engagement in the lesson. However, meaningful student participation does not occur by chance. Teachers deliberately planned to ensure that all their students would engage meaningfully.

For example, teachers at Jim Thorpe Fundamental School in the Santa Ana Unified School District in California considered how special education personnel in general education classrooms could help students with disabilities master challenging academic content. They planned lessons that tapped the interests and resonated with the learning strengths of each student. They thought about how they could ensure that students with disabilities would engage meaningfully and develop an understanding of the information presented through general classroom instruction. Special educators and general educators worked in concert to facilitate each child's mastery of key objectives. As a result, in both mathematics and reading, students with disabilities at

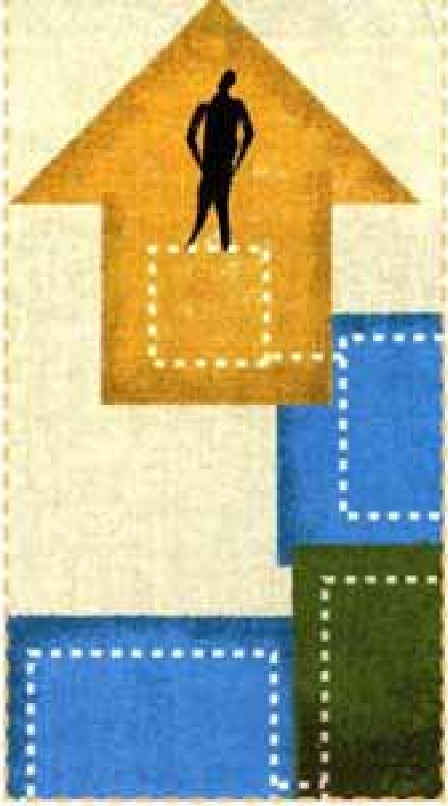
Jim Thorpe performed at levels comparable to all students in California.

Teachers at Horace Mann Dual Language Magnet School in Wichita, Kansas, planned lessons in both English and Spanish that were likely to lead students to understand crucial concepts, regardless of their home language. Teachers did not merely present content and hope that students understood. Instead, teachers sought, found, tried, and refined teaching practices that would build deep understanding of the lesson content, while building students' language skills in English and Spanish.

Teachers frequently engaged students in explaining concepts verbally as best they could in whichever language (Spanish or English) was the language of instruction for the class. In many classes, students were continually asked to use the language of instruction to explain what had just been taught. As a result, native Spanish speakers excelled in classes taught in English, and native English speakers succeeded in academic classes taught in Spanish. Students learned challenging concepts, and they learned how to discuss those concepts in both English and Spanish.

In some of the high-performing urban schools studied, teachers used technology to help them ensure that all students achieved the lesson objective. At Revere High School in the Revere Public Schools near Boston, Massachusetts, teachers engaged students daily in using iPads to pursue mastery of lesson objectives. Students were not simply playing with or exploring the technology. Instead, students used their iPads in ways that made important learning objectives come to life.

For instance, Revere students used their iPads to access the Internet and find multiple sources of information that yielded varying perspectives.



Students were proud of their ability to access information themselves and generate deeper understandings after examining multiple perspectives. Achievement at Revere improved, in part, because objective-driven teachers planned how the Internet could be a powerful tool for making everyday learning objectives more interesting.

Ultimately, objective-driven teachers exhibited a "whatever it takes" attitude when it came to helping students. They were not willing to rely on lessons from textbook publishers who had never met their students. And they were not willing to depend on lessons that had previously "worked" to generate a bell curve of test scores.

A Schoolwide Commitment

The constant pursuit of mastery requires a high level of energy from both teachers and students. In high-performing urban schools, educators help one another and their students sustain this level of energy through strong, positive collaborative efforts. Educators feel like part of a team and know that their administrators and fellow teachers want them to succeed. Thus, they are often eager to provide support to their colleagues. Frequent acknowledgement of progress helps teachers see they are making a difference.

In a similar vein, students in high-performing urban schools perceive that they are respected, appreciated, and valued. They know their teachers believe in them and want them to succeed, so they are willing to invest the effort to master challenging academic standards. Teachers in these schools lead students to expect academic success. Students know that they are being taught rigorous academic content. They see themselves developing deeper understanding of this challenging content, and they become excited about their potential as scholars. ■

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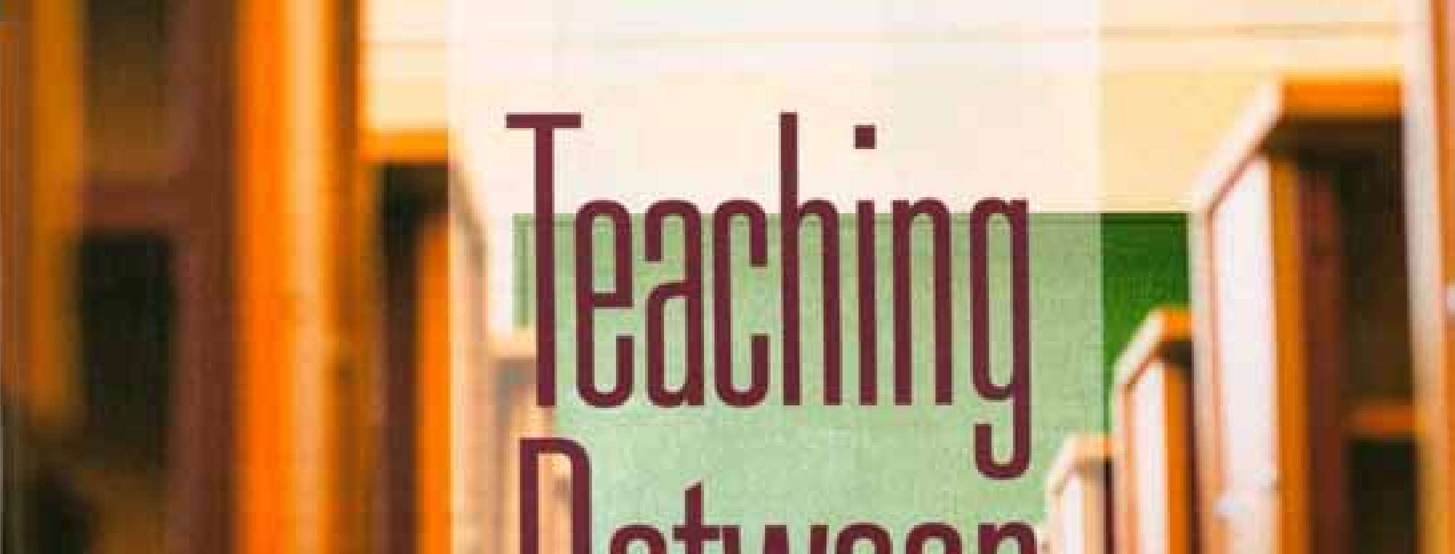
Teaching Between Desks



U.S. educators can use a tried-and-true practice from Japan—kikan-shidō, or teaching between desks—to engage all students in deeper learning.

Bradley A. Ermeling and Genevieve Graff-Ermeling

Watch one of the Japan videos from the Trends in International Mathematics and Science Study (TIMSS)—more specifically, mathematics video 3 on solving inequalities[1]—and you'll see that after giving his students a word problem to solve, the 8th grade math teacher strolls among the students' desks for almost 15 minutes, leaning over to see what each student is doing, making brief comments to each one, and noting on a chart how different students are solving the problem. Some are counting, some are making tables or charts, and some are writing equations.

The teacher clarifies instructions for one student: "Yes, write your explanation on the paper next to the problem." He clarifies terms for another: "This *180 – 10x* you wrote—whose money is this?" He nudges others forward: "So you counted all the way? Is there an easier method to find the answer?" And he supports and acknowledges more complex approaches: "If you try combining this and that, you can make a mathematical expression." "So you wrote a simultaneous equation—OK!"

This process of roving among desks to monitor and assist students' independent or collaborative work is known as *kikan-shidō* (between-desks instruction). We encountered this practice firsthand while teaching and coordinating professional development at a K–12 school in Saitama, Japan (Ermeling & Graff-Ermeling, 2014).

From Japan . . .

We first learned of *kikan-shidō* while participating in lesson study (*jugyō kenkyū*) in Japan with a district-level research group for English teachers. The central feature of lesson study is observing and analyzing live classroom research lessons that a group of teachers has collaboratively planned (Ermeling & Graff-Ermeling, 2014; Lewis, 2002).

During one lesson study project hosted at our school, the English department prepared a lesson for a 9th grade oral communication course and asked one of us to teach the lesson for the scheduled observation. The lesson included teacher modeling and several pair exercises that challenged students to practice speaking English with their peers.

During the post-lesson reflection meeting, one observer suggested a more systematic use of *kikan-shidō*, pointing out that most of the instruction the teacher delivered when moving around the classroom focused on a few pairs of students who struggled with the exercise, whereas intermediate and advanced students received little guidance or support.

The observer suggested spending less time with each pair of students and giving briefer, more concise feedback so the teacher would have time to interact with everyone in the room. He proposed that as the teacher circulated among students, he should note the progress of each one, including any patterns that might warrant whole-class attention. As a result of these observations, the team discussed ways to more intentionally differentiate support for all students during *kikan-shidō* without neglecting those who struggled with the content.

This experience and subsequent observations of Japanese colleagues opened our eyes to the importance of *kikan-shidō* as part of regular lesson preparation, as did our analysis of videos from our own classroom lessons. We saw that the unplanned, cursory exchanges we had with students when they were working on an assignment in class mostly reiterated previous instruction and seldom advanced student learning. We came to understand that the teacher's role during student work time in class—what we chose to focus on, how long we spent with each team or individual, what we chose to say or not say—had crucial instructional value. Improving the use of this time required careful planning.

For decades, Japanese educators have used this practice to engage students in deeper learning around challenging problems and tasks (Sakoda, 1991). In his commentary on the solving inequalities lesson we describe at the beginning of this article, the national research coordinator points out specific video segments in which the Japanese teacher used *kikan-shidō* to engage and support students' independent work:

> The teacher purposely speaks loudly when giving advice to a student so that other students can hear . . . the teacher could exploit the advantages of a whole-class instruction method . . . by doing *kikan-shidō*. The teacher instructs students while strolling among the

> students' desks, thinking about the upcoming order of presentations for successful whole-class instruction.... The teacher carries a lesson plan sheet and writes down the students' understandings of—or difficulties with—a solution, while instructing individual students. (UCLA & the Carnegie Foundation for the Advancement of Teaching, n.d., 05:10)

To the United States

The practice of *kikan-shidō* can prove valuable to U.S. teachers as they work to address new and more rigorous standards in math, science, and English language arts. The intentional use of *kikan-shidō* can elicit, prod, and facilitate deeper learning in all students.

Using data from six cities across the world and more than 180 videotaped lessons from the Learners Perspective Study, which examined patterns of participation in well-taught 8th grade mathematics classrooms, O'Keefe, Xu, and Clarke (2006) outline four principal functions of *kikan-shidō*: (1) monitoring student activity, (2) guiding student activity, (3) organizing materials and the physical setup, and (4) engaging students in social talk. The examples we provide below come from our direct observations of more than 20 U.S. teachers working to improve between-desks instruction and facilitate deeper learning.

Function 1. Monitoring Student Activity

After studying the Japanese TIMSS video on solving inequalities, a high school algebra teacher we observed prepared a lesson that placed students in small groups to solve a challenging multistep problem using systems of linear equations. The problem read as follows:

> Your friend has interviewed for two different sales positions in competing companies. The Stellar Company pays $500 per week plus 10 percent commission on the total dollars from sales per week. The Lunar Company pays $200 per week but offers a 20 percent commission on the total dollars from sales per week. Sales at both companies are seasonal. Your friend wants some help determining which job option is best.

The teacher circulated during group work; recorded the approach that each group selected to solve the problem (table, graph, or system of equations); and asked questions to elicit and understand students' thinking. For students who were using a table to solve the problem, the teacher anticipated that they might struggle to find how the total amount earned would change for each job. She asked questions such as, "How are the variables changing?" and "How fast are the two jobs moving together?" For students who selected a graph, she wanted to see whether they understood the solution conceptually. She asked those students questions like, "What data do you have?" "What are you going to put on each axis?" and "What is the graph going to tell you?" For students using the system of linear equations to solve the problem algebraically, she paid close attention to how they set up the problem. She asked, "What variables did you choose, and what does each represent?"

It's important to clarify that each method the students chose revealed underlying patterns of their thinking. Students who chose a table to solve the problem were typically less comfortable determining appropriate scale and intervals for a graph. They were also less likely to recognize when a problem involved a system of equations. The table represented a concrete and trusted format for organizing data, calculating values, and thinking through the solution.

Students who chose to solve the problem graphically typically recognized the need for two linear equations and saw the graph as a useful way to identify the point of intersection. They felt confident working with a more abstract representation and less computation.

Students who chose to solve the problem algebraically were comfortable visualizing the problem without all the detailed computation or graphical representation. They viewed the system of equations as the quickest, most reliable method and perhaps recognized that graphing could be imprecise when plotting values that involve decimals.

In the course of her observations, the teacher identified several groups to present their solutions at the end of the period. She ensured that each of the three main approaches—table, graph, and system of equations—was represented.

Much like in the Japanese TIMSS video the teacher studied, the goal of this lesson was to help students better understand the continuum of problem solving approaches, starting with more

The teacher's role during student work time in class—what we choose to focus on, how long we spend with each team or individual, what we choose to say or not say—**has crucial instructional value.**

concrete methods (creating a table) and moving toward more sophisticated and abstract ones (using a system of equations). By strategically selecting students to present each method, the teacher highlighted the validity and benefits of all three methods but also pointed out the value and necessity of the algebraic approach for tackling mathematical problems with increased scale and complexity.

Function 2. Guiding Student Activity
It was the first experiment of the year in a 5th grade science lesson we observed. The teacher's goal was to introduce students to the investigative process and teach them to anchor data in descriptive observations. The students would start by exploring simple interactions between liquids and solids; in subsequent lessons, they would use the data to note differences among various physical and chemical changes, discuss patterns that emerged across the data, and draw conclusions on the basis of this evidence.

Using six white powders and six clear liquids—the powders included Epsom salt, flour, and powdered lemonade, whereas the liquids included water, vinegar, and cooking oil—the teacher designed a whole-class experiment with 36 different mixtures and gave pairs of students at least two mystery combinations to analyze. After receiving the mystery liquid from the teacher, students carefully added two spoonfuls of powder to their bags, which listed the number assigned to the white powder and the letter assigned to the clear liquid they were investigating. The teacher asked the students to record each aspect of the experiment in their science notebooks: materials, procedures, observations, and ideas for future investigation.

Once the experiment was underway, the teacher rotated among the desks to support student pairs in developing their observational skills. He listened to student observations, noting when the students offered only vague descriptions, and prompted them to elaborate by asking such questions as, "What do you mean by the mixture 'making noise'?" and "What happened when you first added the powder?"

Adopting "instruction that sticks" means **sticking with the relentless pursuit of incremental improvement.**

The teacher had to continually remind students to keep their observations rooted in sensory evidence—what they could see, hear, smell, and touch—while refraining from telling them what he could readily see and describe. Also, by asking such questions as, "Why do we have notebooks?" and "How will you remember your observations?" he continually impressed on students the importance of recording their observations.

In the early stages of the lesson, most students' observations were brief and simplistic: "They mix." "It's hard." "It's white." Only a few student pairs recorded information in their notebooks. The teacher noted that one group was having trouble describing the physical and chemical changes; the students weren't sure what to write. As the teacher encouraged them to be more detailed in their observations, the students began to note more specific characteristics, such as, "the mixture changed color," "it bubbled at first and then stopped," and "it was clear at first and then got foggy." Students across the class responded well to these individualized prompts and showed improvement in both describing and recording observations, an important first step in developing investigative skills.

Following the experiment, the teacher asked each pair of students to share their data. He then summarized all student responses in a large matrix on the board. One student shared two descriptive words from his science notebook—that the reaction "moved fast"—which the teacher highlighted as particularly interesting because it raised a point about the *pace* of a chemical reaction, an important scientific observation.

Function 3. Organizing Materials and the Physical Setup
In a 1st grade science lesson we observed, students were investigating the basic properties of magnets. The teacher designed an exploratory lesson, placing students in groups and giving each team a carefully organized tray that included different combinations of magnets: horseshoe, rectangle bar, paddle, and ball. The trays also contained a variety of objects that magnets could and couldn't move: steel wool, cotton balls, paper clips, plastic coins, erasers, and a compass. By intentionally including items that could and couldn't be picked up by a magnet, the teacher created a sense of mystery as well as a puzzling situation in which students would need to look for patterns.

Each student chose different items to investigate, enabling them to both individually and collectively explore, compare, and discover magnetic properties. One student discovered how the bar magnets' red and blue ends would pull together, whereas the two blue ends would push away (polarity). Another student created a chain of paper clips hanging from a magnet and observed that if she added more than three, one paper clip would drop off (magnetic strength). The teacher's careful preparation of the diverse trays helped facilitate active inquiry, effectively setting the stage for a rich culminating discussion during which students learned about the unique discoveries from each group.

Students were excited as they described what they learned: "The magnets rolled like magic!" "The two blue ends didn't stick to each other." Because of her intentional organization of materials, the teacher was able to build on these discoveries from her 1st grade scientists, and she finished the lesson by bridging students' observations to the key scientific concepts of attraction, repulsion, and magnetic fields.

We observed a similar focus on organizing materials and attending to classroom logistics in a high school English lesson. The teacher prepared a small-group exercise aimed at helping students shift their revision focus from mechanics and punctuation to quality of content and clarity of arguments. She carefully selected sample papers in advance that had various degrees of weakness in clarity of arguments (for example, lack of a clear main idea or thesis, use of quotes without sufficient explanation, and so on) and removed all student names before making copies for the lesson.

After leading the class through a modeling exercise during which they analyzed different levels of revision, the teacher placed students in groups and provided each team with three papers from a different class period to ensure anonymity and facilitate objective analysis. She also assigned students roles (reader, recorder, commentator) and explained that commentators should pause the group whenever they noticed specific errors with clarity or content.

Instead of briefly reviewing the paper for superficial errors or being preoccupied with whose paper they were commenting on—problems the teacher had noted in previous peer-editing sessions—the students showed increased focus on the substance of the writing and greater willingness to provide specific suggestions for improvement.

Function 4. Engaging in Social Talk

A 5th grade teacher we observed asked students to work in small groups to complete an exploratory exercise about the earth's water cycle. As she circulated and listened to group discussions, she saw one student carefully explaining to his team members the processes of evaporation, condensation, and precipitation.

During a brief lull in the conversation, she took a moment to affirm the student's skillful explanation. Using language familiar to their inner-city community, she said, "That's your new hustle. Instead of working the street corners, you study hard, get an *A* in class—and that's your proof that you can tutor other students. *That's* your new hustle!" The teacher later explained that she often looks for opportunities to offer students alternative choices to counter the more negative influences of their environment.

We also noted the intentional use of this practice in a high school chemistry class. The teacher rotated around the classroom as students cleaned up their stations from a lab experiment and engaged in brief conversation with individual students to build rapport. He asked one student about the opponent for an upcoming volleyball match. He asked another about a sister who was in the hospital for surgery. He assisted the students with clean-up duties as they conversed and gradually switched from social talk to questions about what they learned from the lesson activity.

Preparing for Kikan-Shidō

Teachers can prepare for *kikan-shidō* by thinking through a series of questions and constructing a clear mental image of the lesson activity: What are my goals as I circulate? How will I distribute my time with various groups and differentiate support? What key understandings or misconceptions will I be looking for? What probing questions will I use to check for understanding or advance student thinking? What will I be careful not to say or do that might decrease the rigor of the task? What materials will I need to distribute? When should I engage in brief social conversation with students to provide encouragement and build relationships?

Using a format to plan and reflect on a few key lessons is one way to develop the discipline of regularly thinking through these questions. For example, in the 9th grade oral communication course we described, in which Japanese students practiced English dialogue, our planning template listed common student reactions to the assignment that we should look for, such as reading the conversation without trying to commit it to memory, trying to memorize the dialogue without reading it out loud, and reading or speaking lines mechanically without attempting to convey meaning. The template also listed helpful teacher responses and support during *kikan-shidō*, such as providing feedback on pronunciation and intonation, encouraging students to work on memorization, and providing additional instruction to students who were reciting lines without a communicative purpose.

Carrying a copy of the lesson plan on a tablet or mobile device during *kikan-shidō* is also useful; teachers can review the plan on the spot and take notes as they observe. This kind of planning and reflection will help them develop increasingly nuanced understandings of the choices presented in each *kikan-shidō* episode and the effect these choices have on student learning.

The intentional use of kikan-shidō can **elicit, prod, and facilitate deeper learning** in all students.

Persisting with Kikan-Shidō

Much like in Japan, teachers and administrators will need sustained, collaborative learning opportunities to persist with the slow, steady process of "learning to teach between desks." One study suggests it takes, on average, 20 separate instances of practice for teachers to master a new skill, and the number could be significantly higher for more complex skills (Joyce & Showers, 2002).

Findings from a case study we conducted on teacher change showed that it took at least three semesters for teachers to adopt and effectively implement a new instructional approach in their high school science classrooms, which involved significant adjustments to teachers' "between-desks" instructional routines (Ermeling, 2010). One teacher shared the benefits of this approach, which helped her not only guide student activity but also challenge students with an appropriate level of struggle:

> I just got my scores back: 18/20 passes = 90 percent. Seven students received a 5, six received a 4, which is so much higher than any class ever before. I'm so happy for my students, I just sat down, closed the door . . . and cried and cried and gave thanks. I have to believe I changed the way I taught, that making them struggle really bridged the gap. This was my most enjoyable year of teaching in my 28 years. (p. 386)

From Insights to Change

Adopting "instruction that sticks" means sticking with the relentless pursuit of incremental improvement. It means learning to understand and predict how specific aspects of an instructional practice, such as *kikan-shidō*, will influence learning and how student responses, in turn, might influence teacher actions. It means persevering long enough to understand the nuances of effective implementation—and translating these into practical teacher knowledge and tangible student results. ■

[1]The solving inequalities lesson from TIMSS (Mathematics JP3) is available in its entirety at www.timssvideo.com/49.

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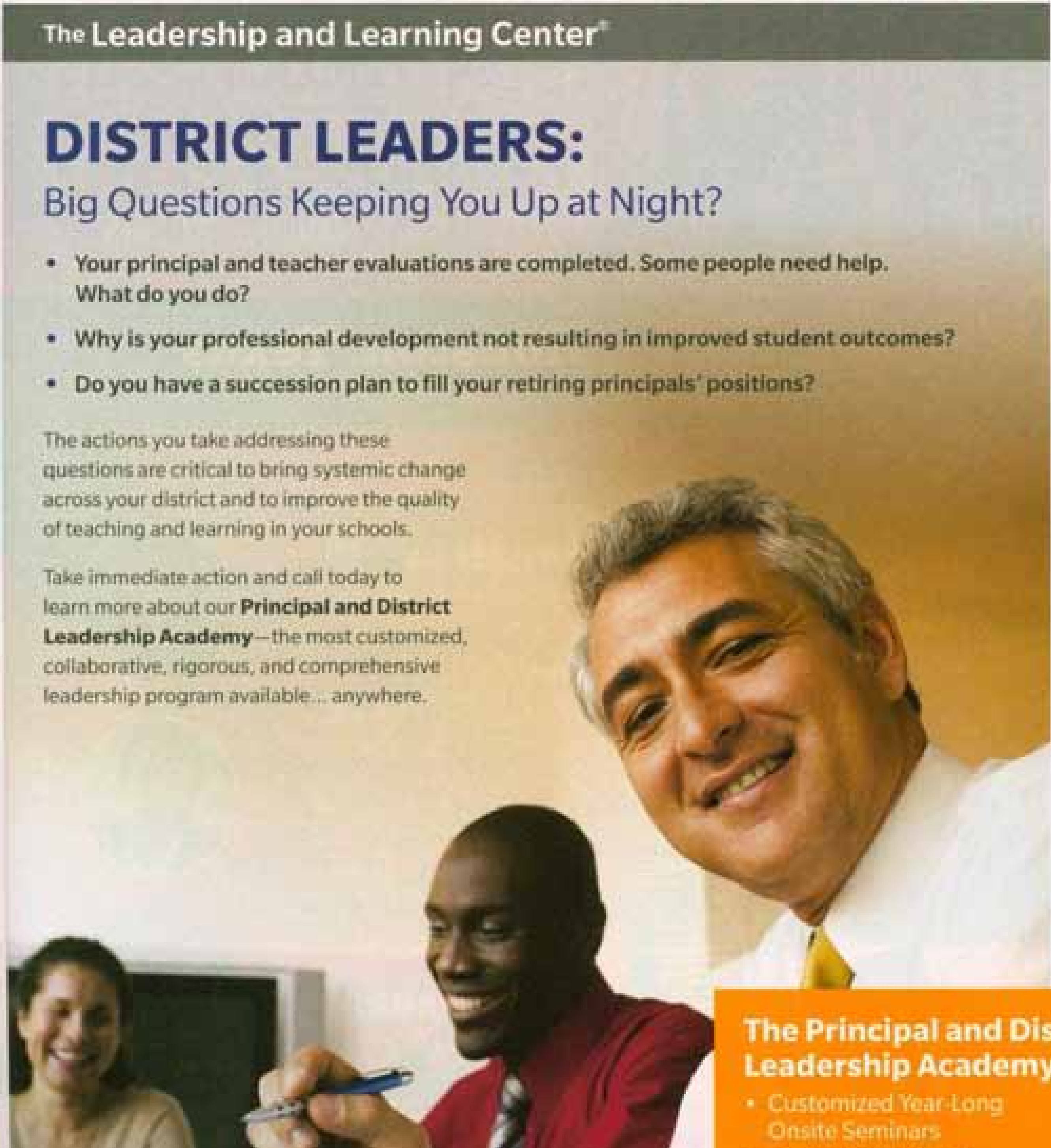
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IT'S TIME FOR
TECHNOLOGY TO
PLAY NICE IN
THE CLASSROOM.

Uncovering the

Marilyn Burns

Teachers often express to me their worry about the need to "cover the curriculum." To respond, I draw on one of my favorite quotes: "You don't want to cover a subject; you want to uncover it." This quote is from *The Having of Wonderful Ideas and Other Essays on Teaching and Learning* by Eleanor Duckworth (Teachers College Press, 1986), a book that's been on my shelf for more than 25 years and one that I return to time and again for inspiration and guidance.

Too often, mathematics instruction gives students the erroneous notion that learning math is all about learning procedures, rather than making sense of ideas.

One of the most important steps in my own growth as a math teacher has been to understand the difference between covering and uncovering the curriculum. I've given a good deal of thought to how to incorporate this difference into my teaching practice.

Uncovering Pi

As a young middle school teacher, I primarily taught each topic the way I had been taught. For example, when my students and I reached the part of the curriculum in which we were required to cover the properties of circles, I presented the formulas for circumference ($c = \pi d$ or $2\pi r$) and area ($A = \pi r^2$), introduced π as the symbol for pi, explained that we could use either 3.14 or 3 1/7 for the value of π, and then had students apply the formulas to solve problems. In other words, I covered the subject, but I didn't uncover it. I taught the formulas for area and circumference and how to apply them, but I didn't help students understand why those formulas made sense.

Since those early years of teaching, I've come to realize that our challenge as teachers is not to find better ways to explain to our students what we want them to learn, but rather to find better ways to ask our students to make sense of what they're learning for themselves. What does a lesson look like when we make the shift from telling to asking? As an example, here's what I think is a better way to help students understand pi.

Because pi is a constant relationship that exists in the physical world, my goal as a teacher is to engage students in a firsthand investigation that can help reveal that relationship to them. To do this, I assemble a variety of circular objects—plates of different sizes, a variety of cups and glasses, coasters, jar lids—whatever I can gather. I ask students to measure the circumference and diameter of these circles. Sometimes I ask each student to measure one circle, and I collect their data on the board for a class discussion. Other times, I ask each student to measure a few circles and then have the students compile and investigate their data in small groups. I ask them, "What do you notice?" And after they've had time to think, I ask, "Now, what do you wonder?"

Asking students what they *notice* focuses them on looking for patterns, structure, and regularity, all important for making sense of mathematical ideas and procedures. Asking students what they *wonder* focuses them on extending what they've noticed to make conjectures. This kind of thinking is fundamental to doing mathematics.[1]

e Math Curriculum

As the teacher, my role is to guide a discussion that helps students see that, for each circle they measure, the circumference is always about three times the diameter. It's important to point out to students that measurement is never exact, and even the best of measurements are approximations. That said, if we measure carefully with the best measuring tools we can find, for any circle, the result of dividing the circumference measurement by the diameter measurement will always be close to 3.14 or 3 1/7. That relationship—the ratio of a circle's circumference to its diameter—is what we call pi.

I've found interesting ways to assess my middle school students' understanding about circles. Although I want to know whether they've learned the relevant formulas, I also want to know whether they can apply that knowledge. One way to assess this is to ask them to solve the problem of measuring the diameter of a tree trunk. To help them envision the task, I model with a standard tape measure and a cylindrical container. The circumference of a container of bread crumbs, for example, measures about 12 1/4 inches, or 31 centimeters. (This is a good opportunity to reinforce for students that measurement is never exact.) After I ask students to predict the diameter of the container and explain their reasoning for their predictions, I measure to show that the diameter is about 4 inches, or a little more than 10 centimeters.

Then I point out that because we can't easily measure across a tree trunk to find its diameter, their task is to design a tape measure that does this. When you wrap this special tape measure around the circumference of the tree, the tape shows a number that's the tree's diameter. Instead of the marks on the tape measure indicating units that are inches or centimeters, they indicate "diameter units." In this problem, the goal is for students to do the math, not to do the page.

> Without a flexible base from which to work, they may be less likely to consider analogous problems, represent problems coherently, justify conclusions, apply the mathematics to practical situations, use technology mindfully to work with the mathematics, explain the mathematics accurately to other students, step back for an overview, or deviate from a known procedure to find a shortcut. In short, a lack of understanding effectively prevents a student from engaging in the mathematical practices.[3]

Embracing the Common Core mathematical practices requires that we help students uncover knowledge by conducting firsthand investigations, working with physical materials when appropriate, and having opportunities to interact with others. However, we also need to recognize that some mathematical knowledge is based on agreed-upon social conventions, not logic. Students acquire this social knowledge by relying on outside sources—a book, the teacher, another student, TV, the Internet, and so on.

Examples of social knowledge are the term *pi* and the symbol π that we use to name the ratio of the circumference to the diameter of circles. No amount of thinking and reasoning alone will reveal this knowledge to students. This is content that we as teachers need to cover. In such a case, teaching by telling is appropriate and necessary. But the actual ratio of the circumference to the diameter is a mathematical constant that exists in the physical world for all circles. Students can uncover this for themselves through firsthand learning experiences. And they should.

What does a lesson look like when we make the shift from telling to asking?

Procedures Versus Understanding

All instruction must foster students' ability to think, reason, and solve problems. Being able to compute answers without also understanding the underlying mathematics is an insufficient and shallow goal for students' mathematics learning. It builds the erroneous notion for students that learning math is all about learning procedures, rather than making sense of ideas. The expertise we should seek to develop in our students is much broader and embraces understanding.

The Common Core State Standards for Mathematics recommend a "balanced combination of procedures and understanding" and caution that "students who lack understanding of a topic may rely on procedures too heavily." The standards describe the consequences when students lack understanding:

Exploring the "Why"

Teaching for understanding demands going beyond basic facts and procedures to ask, Why do we do this? Why does this make sense? The mathematics instruction we provide to students should emphasize meaning, relationships, and connections to help them uncover the curriculum. We should be mindful of what our students understand, not merely what they can do.

To help students understand why things work the way they do, teachers need to think deeply about the underpinnings of numerical concepts. Here are some questions that relate to making sense of mathematics that teachers can think about themselves and explore with their students.

1 *Why is it OK to add a zero when multiplying whole numbers by 10 but not when multiplying decimals by 10?* Discussing this question helps students uncover several important mathematical ideas. One is that in our place-value system, which enables us to represent any number with only 10 digits, the same digits can have different values depending on their position in numbers. The difference between 36 and 63, for example, although obvious to adults, is not always easy for young students to understand.

Discussions can help students understand that when we multiply 25 by 10, we can add a zero and get 250—the digit 2 shifts from the tens place to the hundreds place and the digit 5 shifts from the ones place to the tens place, so the value changes. But we cannot just add a zero at the end when we multiply 2.5 by 10 because in both 2.5 and 2.50, the 2 is in the ones place and the 5 is in the tenths place, so their values are the same. Another important idea emerges by talking about the fact that .5 and .50 are the same and are both equal to 1/2.

2 *Why is the sum of two odd numbers always even?*
Before students discuss this question, it's important to give them time to verify that adding two odd numbers always results in an even sum. I typically have students do this in pairs and discuss with their partners why this might be so. This helps them prepare to offer ideas in a class discussion.

I've seen students come up with several explanations for why the sum of an odd number plus an odd number is even. For instance, one student explained that when you take an odd number of things and put them in pairs, there will always be one extra without a partner. But when you put *two* odd numbers of things in pairs, each of them will have one extra without a partner. These two extras can always be paired, so there won't be an extra anymore.

This question combines investigating how the parity of numbers (that is, whether they are odd or even) connects to the operation of addition. Questions like this help students develop understanding of the properties of numbers and of operations while building their number sense. For follow-up questions, you might ask, Why is the product of two odd numbers always odd? Why is the sum of an odd number and an even number always odd, but their product is always even? What happens when we do a subtraction problem with two odd numbers, two even numbers, or one of each?

3 *Why is zero an even number?*
Even numbers describe integers that are divisible by 2; for example 26 ÷ 2 = 13, so 26 is even. (A number is *divisible* by another when the result is a whole number without a remainder.) You can also use multiplication to explain this instead of division. An integer is even if you can write it as "2 times something;" for example, 26 = 2 x 13, so 26 is even. Or you can use addition: Even numbers can be represented as a number plus itself (13 + 13 = 26, so 26 is even.) Zero passes all three tests: It's divisible by 2 (0 ÷ 2 = 0); you can write it as 2 times something (2 x 0 = 0); and it can be represented as a number plus itself (0 + 0 = 0).

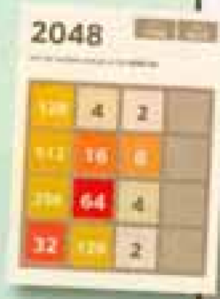
4 *Why does canceling zeros produce an equivalent fraction in the fraction 10/20, but not in the fraction 101/201?*
I presented this question to a class of 4th graders. First we discussed several examples of equivalent fractions that demonstrated we could cancel zeros in their numerators and denominators and have equivalent fractions:

10/20 = 1/2
20/30 = 2/3
20/40 = 2/4

What "2048" Shows Us About Uncovering Mathematics

Several months ago, I received an e-mail from a friend who wrote: *If you want something new to distract you, try playing the game 2048. I'm finding it addicting.*

I downloaded the free app. It's a 4-by-4 array of square tiles; a few tiles start out with numbers on them (always 2s and 4s), but most start out blank. The goal of the game is to produce a tile with the number 2048 on it. You can swipe tiles up, down, or across. When you swipe them so that two 2s touch, the two 2s disappear and are replaced with a 4; if you swipe so that two 4s touch, you get an 8. Two 8s make a 16, two 16s make a 32, and so on. Doubling in this way, you can work your way up: 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, and, finally, 2048. If the grid is completely full of numbers on all tiles and no two adjacent tiles have the same number, the game automatically ends.



The game of 2048 is easy to play, but also vexing. And it's a learning challenge that embodies the qualities of excellent mathematics instruction. I dream about classroom lessons that have these qualities:

- It presents a problem to investigate (how to get to 2048).
- It's accessible to a wide range of abilities (getting started is easy).
- It allows for differentiation (there are different levels and ways to engage).
- It encourages looking for regularity and structure (players strive to figure out how to make more effective swipes).
- It provides the opportunity to make and test conjectures (players test their ideas for more effective moves).
- It's appropriate both for individual exploration and group collaboration (you can play alone or consult with a friend about moves to make).

Now imagine if someone sat you down and taught you how to win the game 2048 without giving you the time to explore and play it yourself. How engaged would you be? That's the kind of experience our students have when instruction "covers" the curriculum for them instead of letting them uncover mathematics understandings for themselves.

Then I presented another fraction and asked whether it was OK to cancel the zeros to produce an equivalent fraction:

Does 101/201 = 11/21?

Some students initially thought the answer was yes; others thought it was no. We had a spirited discussion. Trey argued for yes, because "It works for 102/204 and 12/24—both would be 1/2." Russell supported Trey with another example, 100/200 and 10/20, saying, "It doesn't matter which zeros you cancel."

Elissa argued that those examples were different because you could reduce both of them to 1/2, "but you can't reduce 101/201 or 11/21 to anything." Tina argued that the fractions should be the same because, "If you add 1 to each denominator, you get 101/202 and 11/22, and these are both equal to 1/2."

Sophia used a calculator to divide, and reported that it didn't work: 101 ÷ 201 was 0.5024875, and 11 ÷ 21 was 0.5238095. She came up to the board and recorded these numbers.

Then Nick came to the board and wrote the sequence of equivalent fractions he had written starting with 11/21 to show that 101/201 wasn't in the sequence:

11/21, 22/42, 33/63, 44/84, 55/105, 66/126, 77/147, 88/168, 99/189, 110/210

Emmy gave a place-value argument for why you can't cross out the middle zeros. She said, "If you cross out the zeros, you suddenly are making hundreds into tens, and math doesn't work like that."

Actually, there were three sides, with Leslie offering a minority opinion that the discussion was moot since both fractions were very, very close to 1/2, so you should just say that they're just about the same.

Too often, students learn rules without the depth of understanding that tells them when and when not to apply them. Here students have the opportunity to investigate what happens when "cancelling" to compare fractions, first with fractions for which cancelling maintains the proportional relationship between the numerators and denominators and then with fractions for which it doesn't. The question allows a variety of entry points for students to analyze what makes sense mathematically.

We should be mindful of what our students understand, not merely what they can do.

Those Who Understand, Teach

Learning how to best uncover the curriculum for students has been a long process for me. I've had to learn when to *ask* and when to *tell*. Even more important, I've had to learn *what* to ask and *what* to tell, which calls for thoroughly understanding the mathematical content I'm teaching.

Glenda Lappan, a past president of the National Council of Teachers of Mathematics, addressed the importance of teachers having deep content knowledge in her article "Knowing What We Teach and Teaching What We Know." She wrote:

> Our own content knowledge affects how we interpret the content goals we are expected to reach with our students. It affects the way we hear and respond to our students and their questions. It affects our ability to explain clearly and to ask good questions. It affects our ability to approach a mathematical idea flexibly with our students and to make connections. It affects our ability to push each student at that special moment when he or she is ready or curious. And it affects our ability to make those moments happen more often for our students.[3]

A friend of mine, also a math teacher, has a T-shirt with the following message: *Those who can, do. Those who understand, teach.* I agree with this message. Even with elementary math topics that seem fairly uncomplicated and easy to understand, unexpected twists and turns can emerge during classroom teaching. But if our math knowledge as teachers is robust enough, we can treat these surprises not as difficulties but as opportunities to guide students in uncovering their understanding of mathematics. ■

[1]I was first introduced to this idea by Annie Fetter's talk "Ever Wonder What They'd Notice?" at the National Council of Teachers of Mathematics conference in Indianapolis, Indiana, which can be viewed at www.youtube.com/watch?v=WFvYZDR4OeY.)

[2]National Governors Association for Best Practices & Council of Chief State School Officers. (2010). *Standards for Mathematical Practice.* Washington, DC: Authors. Retrieved from www.corestandards.org/Math/Practice.

[3]Lappan, G. (1999, November). Knowing what we teach and teaching what we know. *NCTM News Bulletin* (online newsletter). Retrieved from www.nctm.org/about/content.aspx?id=998.

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"Don't Just Sit There... Pay

Research in cognitive science makes it clear: Movement is at the crux of learning.

Wendy L. Ostroff

I recently had dinner with a former student who is beginning her career as a kindergarten teacher. According to her mentor teachers, the top priority for kindergarten today is training children to sit still. Our conversation got me thinking about the goals of kindergarten in past decades. When kindergarten was conceived in 1850s Germany, children literally spent their time in the garden, playing together. In the 1940s, after completing her training to teach kindergarten, my great aunt was required to sing and play piano, because the bulk of her days would be spent in song.

Educators knew then what cognitive scientists have seen in the lab: Active play and movement are at the crux of children's learning. So how has kindergarten become about learning to sit quietly? And will better sitters become more focused learners?

Movement—A Prerequisite for Attention

The answer to the latter question is *no*. Yes, children's ability to learn depends on whether they can allocate and sustain focused attention. And the ability to stay on task is one of the strongest predictors of success throughout school (DiPerna, Lei, & Reid, 2007). But sitting still is not the way that deep attention and learning emerge. Cutting-edge research in developmental science and cognitive neuroscience is proving the exact opposite.

Attention is first and foremost an active process. Humans evolved our complex brains within a dynamic surround. For 99 percent of the time humans have lived on earth, we've spent our days outside hunting for food, avoiding predators, and moving from place to place. We needed to pay attention to survive. Consequently, our brains have been set up to operate best in changing environments (Gray, 2013; Medina, 2012).

Even today, young children devote most of their waking hours to movement. Running, jumping, wrestling, and playing are what it means to be a kid. Children's bodies, metabolisms, and bone structure are designed to be active all day (Imus, 2008). Rather than trying to get children to stop fidgeting, we should embrace their tendency to move as a prerequisite for developing focus. Let's look at how movement enhances attention.

Brain Breaks

The attention systems in our brains work in bouts, with the average learner needing a shift in focus every 10 minutes.

Attention!"

This isn't due to laziness or lack of motivation; it's because the human brain constantly scans the environment and orients to things that might be important to seek out or avoid. When teachers build movement into classroom lessons, they provide natural breaks in focus for children, enabling them to harness their attentional resources for short spurts and then seamlessly transition to their next item of interest.

Ideally, make information seem newly relevant every 10 minutes within a lesson, especially if learners are passively sitting and listening. As you approach the 10-minute point, mix it up a bit by telling a joke, playing a song, or even asking for a show of hands. Better still, incorporate movement into the lesson. Have kids clap a rhythm to accentuate word syllables; pair them up to pantomime a story with each other; or do math problems at the board as relay races, with each student doing one operation of a multistep problem.

Taking frequent breaks when studying helps us learn efficiently. Psychologist Hermann Ebbinghaus discovered in the 1880s that attention functions best when it's broken down into manageable episodes. He invented lists of hundreds of meaningless syllables (*dax, bip*) and tested his ability to remember them under various conditions. Even when he devoted the same total amount of attention to the task, Ebbinghaus performed significantly better when he scheduled in breaks.[1] Hundreds of similar studies have been published. Any cognitive scientist will tell you that the best predictor of learning isn't the amount of time spent on a task but how well learners distribute their focus in doing that task.

So create lessons that revisit themes over time. This gives learners an opportunity to approach the information in new contexts and think about it in multiple ways. Teach students to practice material in various settings, preferably with movement involved—such as reviewing multiplication tables while lining up for lunch. Remind students as they prepare for a test that their memory systems will perform better if they study over several sessions with breaks in between.

What kinds of breaks propel attention best? Movement breaks! A student's mind is like an Etch-A-Sketch; it needs to be shaken now and then, to reset the screen and maximize performance. Third grade teacher Marjan Sobhani takes her class outside to run a lap around the school when she sees their eyes glaze over. Megan Linares asks her students to do jumping jacks or stretch in place. These teachers know that the few minutes lost to such actions are easily regained by the quality of students' engagement afterward.

Self-Regulation

In the course of a day, we all go through many different states of arousal. Sometimes we are "up," with hearts pounding; other times we're calm and our breathing is steady. When we're excited or upset, it's very difficult to concentrate. Adults have mostly learned how to regulate their arousal states—to bring the nervous system back down when it's too revved up and gear up when energy is low. We may walk around a bit, splash water in our faces, or get a drink. Children need to learn such strategies. Telling them to sit still generally won't help them change their state.

Self-regulation is a precursor to attention and uses the same brain systems (Rueda, Posner, & Rothbart, 2004). Students who self-regulate well tend to focus their attention easily and, as a result, succeed at school. Because children develop foundational skills for self-regulation in the first five years of life (Galinsky, 2010), early childhood teachers play an important role in helping kids learn to regulate thinking and behavior.

If teachers want to enhance self-regulation and attention in the classroom, the best thing they can do is join students as they explore the materials and lessons—sort of "playing student"—to model the types of behaviors they'd like to see. Help students notice learning materials, and provide opportunities to use them appropriately. Gently invite students to work together or help them transition smoothly into the next activity. A teacher might count down from 10, letting students know that when she reaches 1, it'll be time to move on to the next station; or he could model finishing one task and preparing to move on.

Give children a context and language for self-regulation, and model how to talk about it ("I feel stressed" or "I have lots of energy right now"). Ask a student who seems tired, "Do you need a break?" Or, if a student is clearly tense, ask, "How can you change your state?"

Preschool director Kiera Durett uses blowing and sucking exercises with straws that teach children deep breathing techniques. She shows kids how to do "belly breathing" by putting a beanbag on their bellies and watching it rise and fall. Her students do this when they need to refocus on their bodies. Other self-regulation strategies include counting backward and progressive muscle relaxation. If you teach children such techniques, they'll begin to manage their own states of arousal. You might let students know that it's physically impossible to remain stressed after taking 10 deep breaths.

Recess is of utmost importance here. For children to take care of their emotional and physical states and subsequently refocus, they must have

enough time to take breaks and move freely—and that means recess.

In the 1950s, having three recess periods per day was common, with children expected to sit still in the classroom for roughly the same amount of time they would run free and play (Pellegrini & Bjorklund, 1997). Today, many schools are eliminating recess. This is a disaster for learning and for attention in particular. Research clearly shows that the longer the stretch of time children are confined to the classroom, the less attentive they become (Pellegrini, Huberty, & Jones, 1995). After children play outside, their attention drastically improves.

It may be no accident that the rise in Attention Deficit and Hyperactivity Disorder (ADHD) has corresponded directly to the decline in recess time (Panksepp, 2008). Indeed, typical accommodations for this attentional problem include opportunities to release pent-up energy. In one study, students diagnosed with ADHD showed significantly more inappropriate behavior on days without recess—and greater academic achievement on days with more time on the playground (Ridgway, Northup, Pellegrin, LaRue, & Hightshoe, 2003). We must make sure administrators and school boards know how essential recess is.

Aerobics and Brain Function

Just like it improves muscles, physical movement promotes brain adaptation and growth and allows the brain to respond to future challenges (Mattson, 2004). Specifically, aerobic activities increase the ability of the heart to deliver oxygen to the brain, which affects cerebral structure, cerebral blood flow, growth of new neurons, production of neurotransmitters, and production of proteins responsible for the survival of developing neurons. All these enhancements are directly associated with improved attention (Etnier, Nowell, Landers, & Sibley, 2006).

Students who participate in regular aerobic exercise do better on a myriad of cognitive measures. Children who spend their days running and playing also show increased stimulation of the frontal lobes, less impulsiveness, and

increased ability to focus (Panksepp, 2008). In one study involving 8,000 students, academic ratings and grades were significantly correlated with exercise levels and with performance on physical fitness tests (Dwyer, Sallis, Blizzard, Lazarus, & Dean, 2001).

To enhance the function of the attention centers of the brain for students in your school, support relevant, exciting physical education programs. Phil Lawler, director of physical education at Madison Junior High School in Illinois, sparked a revolution in his school's approach to physical education by introducing a program called PE4life that encourages each student to progress toward his or her personal fitness goals. The students engage in physically strenuous play—both traditional activities like climbing rock walls and newer ones like Dance Dance Revolution—and ride interactive, gaming stationary bikes. They wear heart monitors while doing these activities to assess whether they're working in their optimal aerobic zones (Viadero, 2008).

> **Human brains** have been set up to **operate best in changing environments.**

"Doing the Information"

Movement gives a student's brain a chance to "do" information that the student is learning, rather than to only see or hear it. It gives the mind information through more senses. Reaching, jumping, and balancing teach children how to understand and negotiate the world in a multimodal fashion.

The more the whole body is involved in any learning experience, the more engrossed and focused the learner will be. Physical movement couples nicely with other dimensions of sensation—visual, auditory, or tactile—and being physical keeps students interested because they have to be engaged to keep up, literally, with their marching or dancing neighbors. The diverse brain regions activated when someone performs a movement while learning a concept will become linked together via neuronal networks. The more complex those networks are, the easier it will be to remember that concept later.

You can stimulate attention through movement in virtually any classroom lesson. Have students race around on scooters to match words with their definitions, which are printed on cards around the gym (Viadero, 2008). Let students show the answers to arithmetic problems by jumping the correct number of times.

Kinesthetic experiences expand children's creativity and understanding of their own bodies. As choreographer and science educator Susan Griss (1994) points out, toddlers rolled down hills, flailed their arms, and jumped for joy long before they began to express themselves with language. In a science lesson on sound waves, Griss has students guess the medium through which sound moves the fastest—air, water, or a solid. She lines students up in "molecule formations" (with the kids closest together representing molecules of a solid and those farthest apart representing air molecules) and passes a "sound wave" (shoulder tap) through the line. When the group representing a solid finishes passing the tap down first, all the kids suddenly understand.

Cognitive scientists at the University of Chicago discovered that movement can help students master complex math skills. In a series of studies, they asked one group of 2nd graders to gesture when they explained their solutions to difficult math problems and asked a second group to just verbally explain the solutions. Children who were unable to solve the proble[m] but were in the gesturing group tend[ed] to add new—and correct—problem-solving strategies to their repertoires. When children from the gesturing group attempted to solve difficult math problems later, they were significantly more likely to succeed tha[n] those in the nongesturing group. Th[is] is probably because they had taken in and then explained their own process in a dynamic, active, multimodal manner. They were engaging more than one part of their brain at a time, making more complex neura[l] networks (Broaders, Wagner Cook, Mitchell, & Goldin-Meadow, 2007).

Making the Shift

As educators, we need to shift our thinking on attention from a passive [to] an active model. Findings from the laboratory—as well as evidence fro[m] our own classrooms—make it clear: Movement is the best medium for ha[r]nessing and directing students' focu[s]. Attention (in kindergarten and beyond) is infinitely more complex than merely sitting still and being quiet. It's about being present and aware, about jumping up and saying "yes" to learning. ■

[1]When Ebbinghaus studied a 12-sylla[ble] list 68 times in one day, he could remember it perfectly. But if he distribu[ted] his studying over three days, he only needed to study it 38 times to recall it perfectly (Willingham, 2002).

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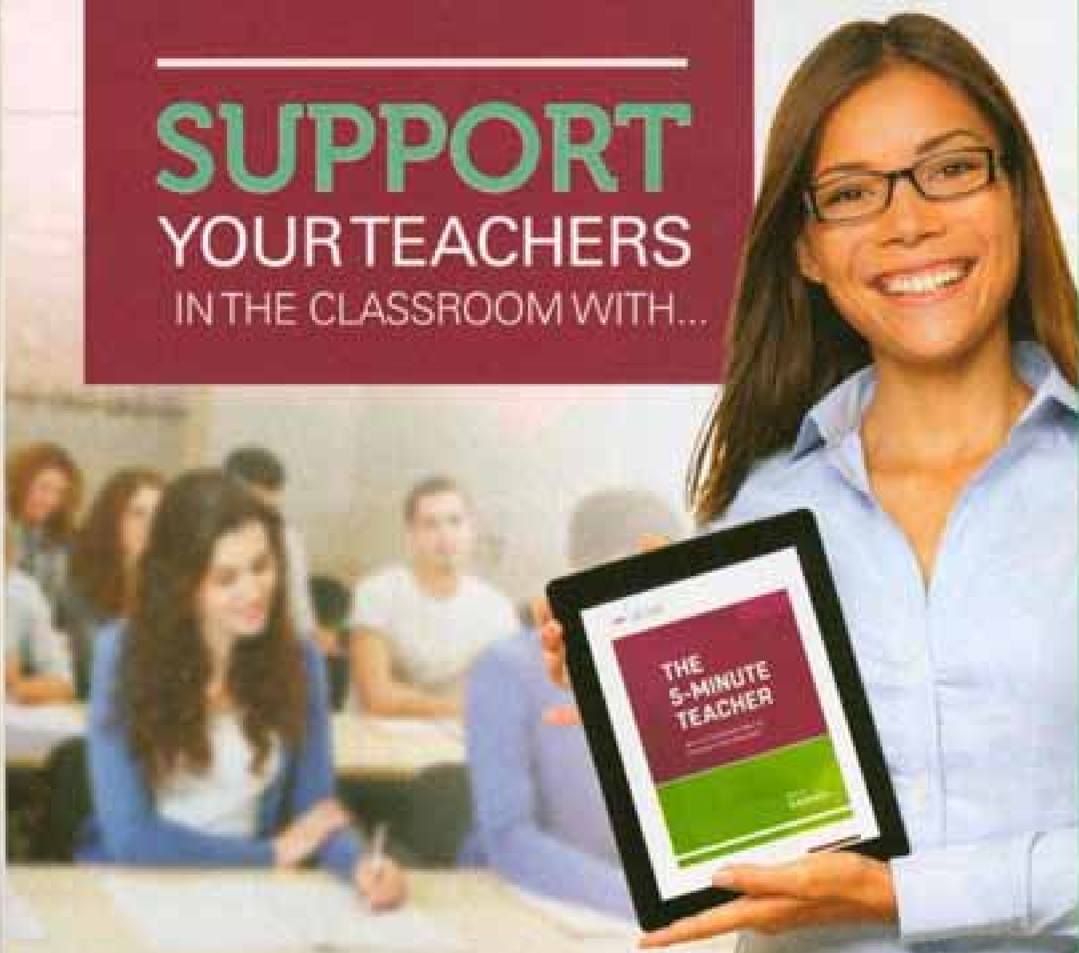

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Bryan Goodwin

Which Strategy Works Best?

"Which teaching strategy works best?" This is a question that many educators ask my colleagues at McREL. It's an earnest question, but it's a bit like walking into a gym full of workout equipment and asking a trainer, "So which exercise is best?" The answer, of course, depends on where you are in your fitness regime and what you're trying to accomplish.

So, too, with instruction. Different teaching strategies support different stages of the learning process—so when it comes to delivering instruction that sticks, the question isn't so much *what* to do, but *when* and *why* to do it. And answering that question starts with a clear understanding of how the brain translates new information into long-term memory.

The Long Journey

Brain researchers and cognitive psychologists tell us that before new knowledge finds a home in long-term memory, it traverses a long and perilous journey through three stages of information processing (Souza, 2011):

1. *Short-term memory*. To learn anything, we must first notice it, or put it into our *sensory registry*. By design, though, our brains ignore or quickly forget most stimuli in our sensory registry. Only a small subset of input is retained in our short-term memory, and it remains there for only about 30 seconds.

2. *Working memory*. When we consciously focus on stimuli, we begin to move that information from short-term memory into working memory, where we can hold information for about 20 minutes before it either decays or continues the journey to long-term memory.

3. *Long-term memory*. Factors like repetition or rehearsal then determine whether information moves into long-term storage. Instead of being stored like folders in a filing cabinet, though, brain research suggests that long-term memories are actually networks of neural pathways and are often retrieved through association with other words, settings, or sensations (Jensen, 1998)—which may explain why the smell of fresh cookies can remind us of our grandmother's home or recalling that we read *Macbeth* beneath a tree can help us conjure up the words that follow the line "tale told by an idiot."

When it comes to delivering instruction that sticks, the question isn't so much what to do, but when and why to do it.

Understanding what happens at each of these stages of learning offers a useful starting point for mapping teaching practices onto the learning process, thus helping students develop "sticky" long-term memory and deep knowledge. Here's what research suggests about where some tried-and-true instructional strategies might be most effective.

For Short-Term Memory, Call in Emotion

Because our senses are constantly bombarded with stimuli, our brains rely on a pecking order to filter out most of them. Stimuli that trigger fight-or-flight responses get our attention first, followed by those with emotional weight. Experiences that offer new learning without emotional content are less likely to make it past the filter and into our sensory registry (Souza, 2011).

This hierarchy suggests that students must feel safe and emotionally engaged before much learning occurs, supporting what most educators intuitively know—positive relationships with teachers are crucial to student success (Goodwin & Hubbell, 2013). It also confirms the value of including an emotional hook at the launch of a lesson. A study of 104 college students found that students who were shown films designed to elicit *positive* emotions like amusement or contentment demonstrated better attention and greater openness to new knowledge, contemplation, and effort than did students who viewed films designed to elicit *negative* emotions like anger or anxiety (Fredrickson & Branigan, 2005).

In Working Memory, Manage Cognitive Load

Once we've gotten students' attention, we must help them move information into their working memory. Researchers have found that when information is simply presented orally, we only retain 10 percent of it three days later, but when it's presented along with a powerful image, we recall 65 percent (Medina, 2008). Such findings suggest that nonlinguistic representations, such as graphic organizers (Beesley & Apthorp, 2010), may be useful at this stage of learning to help students process new information.

It's also important to recognize that our working memories generally hold only about seven bits of information at a time. (For younger students, it's even fewer.) If we introduce too much information at once, we may overload students' working memories, causing fatigue and frustration.

One way around this limitation is helping students mentally cluster information into larger concepts, or main ideas (Bailey & Pransky, 2014). We also know that working memory tends to time out after 5 to 10 minutes for preadolescents and 10 to 20 minutes for adults (Souza, 2011), so it may be best to present new information chunked into shorter segments, providing opportunities for processing in between.

For Long-Term Memory, Incorporate Rehearsal

Whether knowledge moves from short- to long-term memory depends on a variety of factors, starting with the extent to which learners make personal meaning by relating new knowledge to their own experience (Souza, 2011). Over the years, psychologists have conducted many studies of this *self-reference effect*. A meta-analysis of 129 such studies, for example, found significant effects on memory when participants memorized lists of words by relating them to personal experiences (Symons & Johnson, 1997).

Not surprisingly, classroom research has found positive effects for asking students to set personal learning goals and objectives (Beesley & Apthorp, 2010). This research suggests that the most powerful time to emphasize personalized learning goals—to help students answer the question, "What's in it for me?"—may not be when we want to capture students' attention, but rather when we want to help them move learning into long-term memory.

Perhaps the most important key to long-term memory lies in the simple notion of repeat, repeat, repeat; rehearsing new knowledge and practicing new skills to reinforce neural pathways in our brains (Souza, 2011). But not all practice is created equal. *Massed* practice (sessions grouped together) can be useful to develop automaticity with a new skill, but *distributed* practice (sessions spread over time) is more strongly correlated with long-term memory (Rawson & Kintsch, 2005). Similarly, *rote rehearsal* (for example, memorizing lists through mnemonics or other techniques) can speed automaticity and information recall, but *elaborative rehearsal* (for example, paraphrasing or summarizing learning, engaging in reciprocal teaching, making predictions, or generating questions about learning) seems to be more effective in supporting long-term memory and accuracy (Benjamin & Bjork, 2000).

Not Just What, But When

The teaching strategies mentioned here reflect only a small fraction of an expert teacher's repertoire. The key point, though, is that just as different physical exercises serve different purposes—to build strength, shed weight, or improve cardiovascular health—different teaching techniques serve different purposes in the learning cycle. Expert teachers need to have as much knowledge of cognition and learning as personal trainers have of physiology and exercise (if not more) so that they understand not just what to do, but when and why to do it. With that expertise, teachers can serve as personal trainers for student learning.

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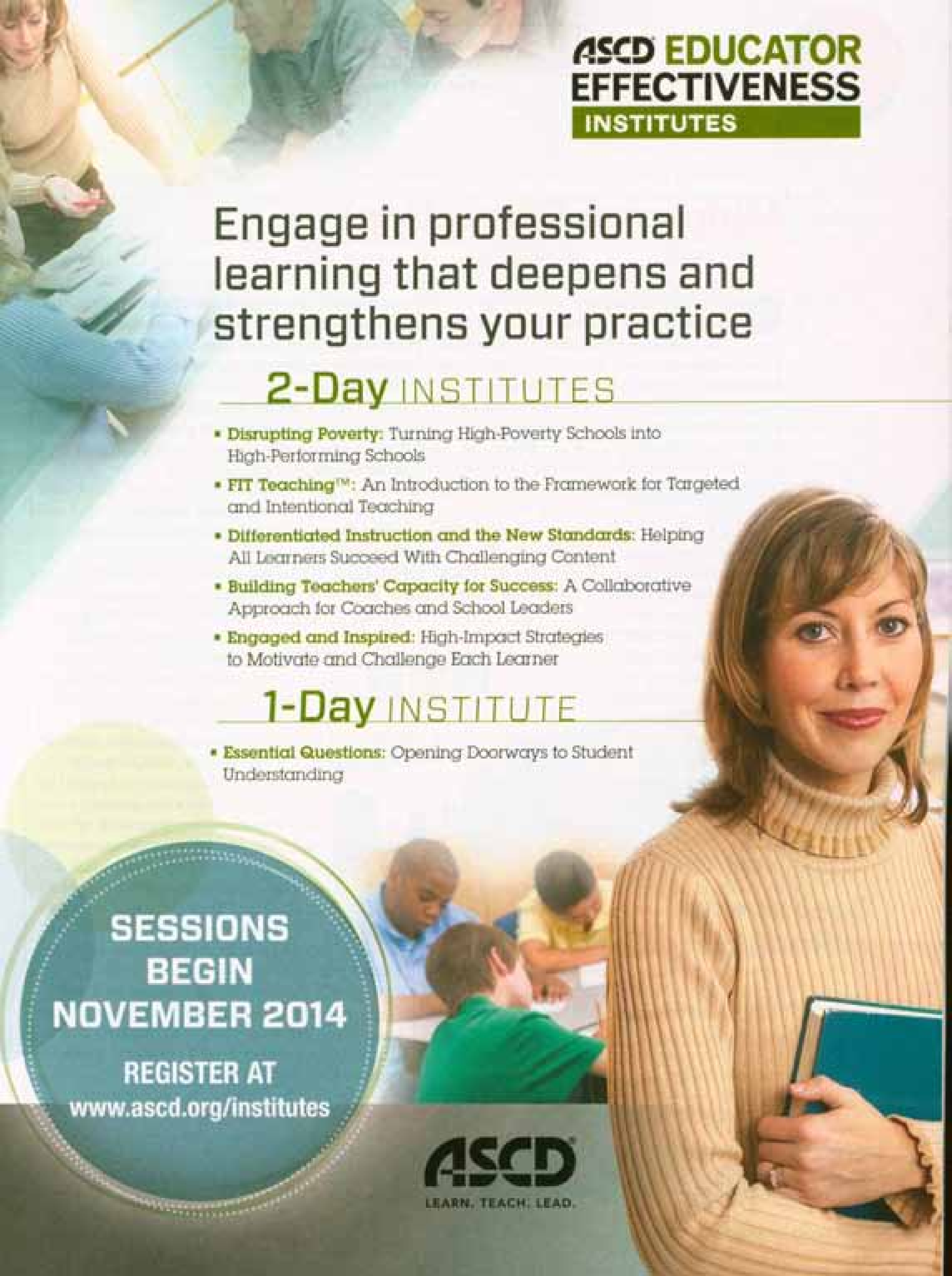
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Doug Fisher and Nancy Frey

Midcourse Corrections

Both of us love the global positioning systems (GPS) we have in our cars, but for somewhat different reasons. Doug, who's a native Californian, takes the GPS directions under advisement, comparing the recommended route with his favorite familiar route to see which one is better. Nancy, who's not from California and is directionally challenged anyway, follows her GPS directions faithfully to improve her chances of arriving at her intended destination.

We both agree, though, that the GPS provides the timely midcourse corrections we sometimes need. And so it goes in classrooms. Teachers routinely collect a variety of information and use it to make the midcourse corrections that keep their students on track.

> Like GPS directions, frequent checks for understanding can increase the likelihood that we'll end up at our intended destination.

GPS for the Classroom

The practice of checking for understanding is an essential tool for teachers to determine whether the instruction they're providing is sticking. Research has found that, to be useful for students, our feedback must be goal-referenced, timely, ongoing, specific, understandable, and actionable.[1] And these same qualities are what make the feedback we collect about student performance most valuable to teachers. Information about a learner's progress is not useful for adjusting instruction if it is purposeless, delayed, vague, or undefined.

So how can we make checks for understanding more useful and dynamic? An encouraging development is the availability of a variety of apps for tablets and other mobile devices, which can help teachers gather data to assess students' knowledge and needs. One method of immediate formative assessment is an audience response system, which enables the teacher to witness learning in real time, discover partial understandings or misconceptions, and respond with further instruction and explication.

See It in Action

In the video that accompanies this column (www.ascd.org/el1014fisherfrey), mathematics teacher Aimee Suffridge uses an audience response system to gauge how her students solve a problem. It is early in the school year, and she presents her students with a mathematics problem similar to those that will appear on the state test. One purpose of the activity, which she implements several times a week, is to prepare students for this test. But the activity also serves at least two other purposes: to guide a classroom discussion that helps students explore their mathematical thinking and to gauge students' mathematical reasoning so that Aimee can make decisions about further instruction. She uses the following format:

1. Present a problem or question and have students respond individually using the audience response system device.
2. Without showing them the results, ask students to talk with others about why they chose

WATCH the Video

See how a teacher uses audience response software to assess and develop her students' mathematical reasoning abilities at www.ascd.org/el1014fisherfrey.

a particular answer, and listen to the reasons students offer for their choices.

3. Reopen the poll and invite students to answer the same problem again, either changing their response or sticking with their original answer.

4. Display the results, including the number who selected each answer choice. Discuss the reasoning used for each answer with the class.

5. Provide follow-up instruction as needed for individuals, groups, or the whole class.

Low-Tech Works, Too

Teachers in responsive classrooms also routinely use a variety of low-tech approaches to gather the data they need to make instructional decisions. In fact, gathering data isn't really the challenge for most teachers; practices like using pre-assessments before instruction and short quizzes immediately after are common. But data quickly become unmanageable if there isn't a plan for organizing the information in a meaningful way.

One method is to use three sort-it-out boxes. At the end of the lesson, pose a question to the class that captures the learning target. Students insert an index card with their name into one of three labeled boxes:

- *I know it, and I can explain my thinking.*
- *I know parts of this, but some of it is still confusing.*
- *I don't know it yet, and I need help.*

It's best not to have students write what, exactly, they're having difficulty with; those who are confused about the content often don't yet have enough knowledge to determine what they're missing. But the sorting boxes enable the teacher to group for the following day. He or she can now identify who can serve as a peer tutor (*I know it*) to the students who need just a bit more information (*I know part of this*). In the meantime, the teacher can spend time with the students who need more instruction (*I don't know it yet*).

With experience, students become more adept at assessing their own learning and identifying what level of support, if any, they need. In terms of organization, this method is especially useful for secondary teachers who teach multiple sections; grouping for the next day's instruction involves simply dividing the name cards into three categories.

Organization is essential for closing the feedback loop and making midcourse corrections. Like GPS directions, frequent checks for understanding can increase the likelihood that we'll end up at our intended destination. In addition, the practice of collecting timely feedback on student performance helps us continually refine our lessons to optimize their efficiency and effectiveness. And isn't that what we all hope for? EL

[1]Wiggins, G. (2012, September). Seven keys to effective feedback. *Educational Leadership, 70*(1), 10–17.

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Doug Johnson

Who Owns That Course?

A teacher in my district has written an amazing curriculum, but he's created it on his personal website. What if he leaves, and the district lacks rights to it? —curriculum director

Can my teachers sell study guides they've made for their classes online? —principal

Why should I develop an online course instead of using a textbook? The district will own the copyright to anything I create, and if I take a job in another district, I'll have to do it all again. —teacher

With many educators taking advantage of new technologies to create their own materials—units, study guides, and whole courses—I often hear questions like these. Teacher-created materials are increasingly popular. Curriculums based on standards, rather than textbooks, often call for customized units, and the increase in learning through digital content delivery systems like Moodle creates a demand for original content. An enterprise called Teachers Pay Teachers advertises itself as an "open marketplace for educators to buy, sell, and share their original resources."

> Determining on whose time a product is created has become difficult as work and personal life blend.

Teachers creating materials of commercial value to others? What a concept! But it raises sticky questions about who owns these creations. If your school hasn't begun to develop policies about the intellectual property (IP) rights surrounding employee-created materials, now is the time.

School districts need to set clear policies about who owns original materials, for the sake of both the institution (which needs assurance that materials created by a teacher paid with public dollars will remain available after the creator leaves) and the creator (who may take personal time to develop materials and want to use them in another district—or sell them).

What Works for Universities

Universities have already begun creating intellectual property policies, and K–12 schools might look to them as models. For example, the Minnesota state colleges and universities board policy on intellectual property[1] gives some guidance. The policy recognizes three types of intellectual property and treats each type differently:

- Institutional works "made for hire in the course and scope of employment by employees or by any person with the use of college or university resources"—things like course outlines—belong to the institution.
- Scholarly works that are "creations that reflect research, creativity, and/or academic effort"—such as syllabi, textbooks and course materials, distance learning works, journal articles, literary works, works of art and music, and computer programs—belong to the individuals who created them.
- Personal works "created by an employee or student outside his or her scope of employment and without the use of college or university resources" belong to the individuals who created them.

In other words, postsecondary institutions tend to give ownership of products that are created by faculty or students to the people who created them.

. . . May Not Work for Schools

Most K–12 schools, however, keep ownership of such products. Here's language (slightly revised for brevity) from a typical K–12 school board intellectual property policy:

> Unless the employee develops, creates, or assists in developing or creating a publication, instructional material, computer program, invention or creation

entirely on the employee's own time and without the use of any school district facilities or equipment, the employee shall immediately disclose and, on demand of the school district, assign to the school district any rights to that material.

It can be argued that K–12 schools need more rights to teacher-created materials because their curriculums are more standardized and in more continuous use than those of a university. Material that a K–12 teacher creates for a class that supports state standards can be used by many teachers for many years. In contrast, from what I've seen of postsecondary courses, each instructor is likely to start from scratch, following only general course guidelines. Accessing good content created by another instructor isn't as important.

That said, two factors are making K–12 institutions' stringent demands to own intellectual property less defendable. First, determining on whose time a product is created has become difficult as work and personal life blend and schools expect teachers to do a lot of work outside their "contract day." The other factor is the growing acceptability of Creative Commons licensing (www.creativecommons.org), which provides less restrictive use of materials than traditional copyright laws. Creative Commons offers creators a way to give others rights to use their original materials in prescribed ways without giving up ownership of these works.

Alternative Approaches

Some education organizations that have teachers create courses or materials set out clear intellectual property rules up front for each specific project. Teachers might create a course for a predetermined payment, for instance, knowing they'll have access to that course through Creative Commons but won't own it. Monitoring and determining ownership of products on a project-by-project basis, however, would be burdensome for a district.

A better approach might be that of my district, Mankato Area Public Schools in Minnesota. Our policy gives ownership of teacher-created material to *both* the teacher and the school. One interesting attribute of intellectual property is that multiple people can use it at the same time, unlike most physical property. Here's how the relevant section of our policy reads:

> Unless otherwise agreed upon and put in writing, all employee intellectual property . . . will have joint copyright ownership. The following provisions apply:
>
> - Neither party may place any restrictions on its use by the other party.
> - Both parties may use the work for commercial purposes (sell it, sell it as part of a larger commercial work like a book or for-pay course, or use it in presentations/workshops for which an honorarium is given).
> - Neither party may make claims to any profits made by the other party.
> - Neither party may limit the other party's right to assign a Creative Commons license; however, neither party may place the work in the public domain without the written consent of the other party.
> - The teacher may continue to use the work when he/she leaves employment with the district.
> - The district may continue to use the material after the teacher is no longer employed.[2]

The Mankato district defines teacher-created materials as "publications, instructional materials, inventions, and creations that employees may develop or create, or assist in developing or creating, while employed by the school district"—anything created during contract hours, using school equipment, or as part of contractual duties. I honestly don't see any losers in this policy—except copyright lawyers.

The chance that a district will need to enforce intellectual property rights is small, whereas the risk of perturbing teachers by stating that the district owns the rights to any materials they create is great. If we want to encourage educators to design original instructional materials—especially as we move toward online learning environments—we'll need to design creator-friendly policies that still gi[ve] the institution some rights. ■

[1]See the entire policy at www.mnscu.edu/board/policy/326.html.

[2]See Mankato District's entire policy at www.isd77.org/sites/isd77.org/files/files/472.pdf

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Thomas R. Hoerr

Authority in an Age of Distrust

The president of a local university agreed to step down after 20-plus years at the helm. His top-down attitude and fierce leadership style were no longer acceptable.

A principal complained that teachers politely listen to her curriculum ideas but implement them only sporadically.

A superintendent told me that it's difficult to get anything done these days. "Everything is a battle," he said.

A common thread in these situations is that leaders have less authority than they did in the past. Authority is different from power: We still have power to make decisions that affect teachers and students, but it's hard to get the consent and support of others, which is necessary if we want to get big things done.

> Authority doesn't come from a title, degree, or position. It comes because others believe in us and trust us.

Too often these days, people don't assume that leaders are knowledgeable or sincere. That's true in politics, business, and, alas, in schools. Our societal expectations have changed. Virtually all the education leaders that I know are people of wisdom and integrity. But too often they're operating in a climate of cynicism and distrust. What can be done?

Maintaining Relationships

Our authority stems from our relationships with others; they need to know that we're on their side even if they don't always agree with our decisions. Consequently, the most important leadership skill is listening. In reality, even if we always hear, we don't always listen. Hearing is merely auditory; listening means taking time to understand and consider others' perspectives. When we listen to others, we let them know that we respect them. However well we think we listen, we can do better; it's that important.

We must also recognize that relationships require ongoing reinvestment. We cannot just assume our teachers will trust that we work from a shared vision that keeps their interests in mind. How do your teachers know what you believe and value? When was the last time you talked about your vision for your school with your faculty? Try beginning the year each fall with a State of the School talk that includes what you believe and hope to see.

A focus on relationships is especially important in today's score-obsessed culture. Yes, test scores are important—but they only capture a piece of a child's growth. Our faculty needs to know that we see students as more than percentiles and teachers as more than people who teach to tests. Think about beginning a faculty meeting by giving everyone an index card and asking them to write their conclusion to the sentence, "When I think of my students, I believe…" Have teachers share their comments aloud—with you reading yours first. This exercise will engender a valuable dialogue and can be a consensus-building step.

Sharing and Listening

Isolation diminishes authority, so it's important to share and share some more. People often want to know what's happening even if it doesn't directly affect them. What's being talked about at the central office? How do attendance rates and discipline patterns compare to a year ago? What new strategies are you trying? What are you reading? It's also valuable to create opportunities for teachers to share what they're doing with the rest of the faculty. This sets the stage for everyone to learn with and from one another.

Throughout the year, I send out surveys to solicit teachers' thoughts on what's happening at school and on my performance. Better than surveys, however, is bringing people together and listening to them. Last year, I convened teams of teachers for "Joyful Learning, Joyful Teaching" meetings. I asked them how I could help ensure that joy was the norm at our school. I recently convened a group of teachers and asked them what they thought about our school climate. The discussion was framed around two questions: "Does our climate support student growth?" and "Does our climate support your growth?" Most of what I heard I already knew, but I also heard some things that worry me. Many of my teachers feel there are too many curricular thrusts and directions, and they're concerned that we keep adding things to their plate.

As essential as listening is, it's only the beginning. Unless we communicate what we have learned, others might think that their voices didn't matter. I wrote a joyful update memo to the faculty after last year's meetings, for example, summarizing what teachers said about fostering joy and what I would do—and I will also share the information and plans from the school climate meeting. Hearing without listening can be worse than not hearing at all, so it's important to let people know how we'll use what we learn from them.

Authority doesn't come from a title, degree, or position. It comes because others believe in us and trust us. They know we care, and they know we listen. This can build up over time, but it can erode quite quickly. Every year, we need to reinvest in our relationships with our faculty. What can you do to show that you've listened? ■

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Follow-up from My May Column

In last May's column, "The Top Ten To-Do List for Summer," I suggested 10 activities principals might do over the summer. Well, practicing what I preach (at least some of the time), here's my report on how I did with a couple of those tasks.

First, I handwrote a personal note to each staff member, thanking each person and offering ideas or encouragement for the year ahead. This took longer than I expected! The most difficult part was getting started, but once I began, it was fun to connect with folks. The response has been extremely positive. Most of my staff made a point of contacting me to tell me how much they appreciated the gesture. Yep, it's something I will do each summer.

I also stayed off e-mail for three days! This wasn't as difficult as I feared, and I relished having an extra 90-plus minutes each day. It turns out that I didn't miss much, although it did take quite a while to wade through and respond to messages when I logged back on. My take-away: I need to force myself to spend less time on e-mail.

How about you? How was your summer? Any reports or suggestions? Let me know at trhoerr@newcityschool.org.

Carol Ann Tomlinson

The Stage as a Classroom

I learned my most powerful lessons about learning that "sticks" not in the classrooms where I spent seven hours a day teaching, but in an extracurricular activity I led. For 15 years, I directed a full-length play every spring. My actors and actresses ranged from 12 to 15 years old.

The plays we worked on were a stretch for them: *To Kill a Mockingbird, The Diary of Anne Frank, David and Lisa, I Never Saw Another Butterfly, Annie*, and so on.

We worked on the productions almost daily for 12 weeks with a focus and a fervor that were consuming. If you signed on, you didn't miss rehearsals. You memorized lines, as there were no prompters; and if something went wrong for one actor, you helped fix the problem so no one in the audience had any idea there was a problem. Whether you were a lead, an actor with fewer lines, a lighting technician, or a prop setter, you "stayed in character" when rehearsals or performances were in progress. Both the adults and the students made it clear that they expected visible professionalism. Every year, their goal became to create an audience experience that was better than the year before.

> We worked on the productions almost daily for 12 weeks with a focus and a fervor that were consuming.

I recognized many reasons why the plays were important. The challenge level was high—and there was a team that pulled together to ensure that everyone succeeded. Students felt part of something larger than themselves. We worked together to understand the play rather than just memorize it and repeat lines. There were roles for all sorts of people with all sorts of strengths. Every person was indispensable, and every incremental improvement—in projecting lines, moving sets silently in the dark, or applying makeup effectively—was celebrated by many people.

There was a very real audience. The students generally performed five or six times for about 2,500 to 3,000 people total. Students had to dig deep within themselves to find experiences, will, creativity, and skill to do jobs that some people thought early adolescents couldn't do.

Learning Why It Worked

During those years when I spent each spring directing plays and each school year translating what I learned from those plays into my classroom, I had no precise language for what made on-stage learning stick. I had no tidy categories for thinking about what I could do in my classroom to create the same sort of learning experiences. Only much later did I encounter the work of Edward Deci (1995, 2012) and Richard Ryan (Deci & Ryan, 1985), who have spent their careers studying human motivation.

I think if they'd observed our plays develop, Deci and Ryan would have said this work provided three key elements that led to self-motivation, excellence, and learning that sticks: autonomy, competence, and connectedness. Students were motivated and thus could work with a lot of autonomy. They also valued the content, process, and product involved. Kids understood that their growing competence was key to the success of something big. They were part of a connected team and felt the power of relationships.

As a director, I supported student autonomy, competence, and connectedness as well. I helped develop a meaningful rationale for the work we were doing. I treated that work as important and worthy. Trying to understand the student's perspective, I asked myself questions like, How can I help this young person connect with this role?

How might it connect with his or her prior experiences or key strengths? I made time for students to explore such questions themselves and to develop deep understandings of the content of the play—and the role they assumed in making that content meaningful.

From the beginning, the students knew that my goal as director was to become increasingly superfluous. If the play worked, it would be because the students learned how to make it work. With each play, I gave the actors the reins of learning as soon and as often as possible.

Deci's work indicates that when teachers support independent learning, students will experience the three essentials of autonomy, competence, and connectedness, and learning will stick. Those years of experience directing young people on stage taught me a great deal about how to place them on center stage in classrooms as well. Good lessons with a long reach. ■

With each play, **I gave the actors the reins of learning** as soon and as often as possible.

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Tell Me About . . .

A Practice That Works in Your Classroom

Student-Created Portfolios

In all my years teaching poetry in high school, the one practice that students remembered years later was using a portfolio approach that put them in control of their learning. After I explained the curriculum goals for the unit, students brainstormed ways they could accomplish the goals. We worked as a team, collecting poems, reading them together, tearing them apart, and learning how to write about poetry. Students collected their artifacts in a portfolio and wrote an extended reflection on what they had learned. I gave extra credit for writing an original poem. I always asked for someone to donate their portfolio as a model, but no one ever did!

—Timothy Dohrer, director, teacher preparation, Northwestern University, Evanston, Illinois

Seamless Differentiation

In my math classes, I use a collaborative strategy called *trail run*. Partnered students complete a cycle of questions of varying difficulty on content that we've recently studied. Students stop at stations and read multiple-choice questions. They discuss solution methods, and they are then directed to move to another station depending on the answer they chose. Students catch their own mistakes when they realize they've skipped one station or repeated a station they already visited on their "trail."

Strategies like trail run present students with learning tasks of varying difficulty, thus appealing to and challenging all students at once. I've found that such strategies are a better way to differentiate instruction than assigning individual students to less difficult or more difficult tasks.

—Sean Padilla, 7th grade math teacher, School District 102, LaGrange Park, Illinois

Belief Statements

Belief statements encourage and motivate my students in an urban school. Each morning, before we begin any work, we recite a belief statement for the week. I read my belief statement about students, and they read the same belief statement about themselves. For example, I read aloud, "I believe I teach the most capable students in our school. You are alert, you are ready to learn, and today you will be successful." My students then read aloud, "I am a capable student. I am alert, I am ready to learn, and today I will be successful." This strategy affirms students' worth and ability and sets the tone for the day.

—Kathleen Foster, teacher, Jennings School District, St. Louis, Missouri

Socratic Circles

Socratic circles help students understand their reading more deeply. Students interact with the text and have to listen to and build on the views of others. It is a powerful way of teaching that puts the focus on the student. Well-selected texts can ensure that students retain and deepen their knowledge.

—Louise Robinson-Lay, head of curriculum, Berwick Grammar School, Victoria, Australia

Revealing Relevance

When students ask, "Where will I use this in real life?" I show them! For example, when I teach percentage mark-up in math, I invite a relative of mine who works in retail to do a Google Hangout with my students to discuss how she uses this skill in her job every day. It's always more effective to break down the classroom walls and provide authentic experiences.

—Melissa Murphy, math and special education teacher, Belmar Elementary School, Belmar, New Jersey

Student Sharing

I collect articles related to the topic being studied. I distribute them—one to each student—and allow five minutes for students to glean at least one interesting fact from their article. Then, one student at a time heads to the flip chart to record his or her interesting fact. (A little creative tension is created when each fact-recorder finishes and chooses the next recorder.) After everyone has had a chance to record his or her fact, we spend class time discussing the new information.

—Marlene Caroselli, retired English teacher, Rochester, New York

Guided Field Trips and Simulations

Although they are often the first items to get cut when budgets are small and time is short, guided field trips and simulations create learning that lasts for decades. These are the experiences that students recall years later when they think back on their education. Of course, field trips and simulations take planning to ensure that the focus is on the learning goals and not just on getting out of the classroom or doing something different. We don't want students remembering the time they played on the beach; we want them remembering the powerful lesson about Lewis and Clark's exploration and what it must have been like to see the Pacific Ocean for the first time. If we invest in the work ahead of time, the payoff can be huge.

—Molly Burger, middle school principal, Saigon South International School, Ho Chi Minh City, Vietnam

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Attendees will connect with leaders and experts from school districts across the United States as they learn about the latest breakthroughs in school and district administration and about new strategies and technologies for improving school performance.

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Registration is $429 for ASCD members and $493 for non-members. ASCD is also offering discounts for teams: When four people from the same school or organization register together, the fifth registration is free.

Attendees are encouraged to follow the conversation on Twitter and connect with other educators by using the official hashtag #ASCDCEL14.

To learn more about the ASCD Conference on Educational Leadership, visit www.ascd.org/CEL.

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ASCD publications have received four APEX Awards for Excellence. *Educational Leadership* won

- For its September 2013 issue on "Resilience and Learning."
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Education Update won

- For its January 2014 issue, which featured articles by John Micklos Jr. ("Boys Can Write") and by *Education Update* managing editor Sarah McKibben ("Mastering the Flipped Faculty Meeting").
- For Newsletter Writing, for Sarah McKibben's November 2014 article, "Tapping into the Power of Gratitude."

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More than 200 ASCD e-books in EPUB format are now available for purchase in the Apple iBooks Store (www.apple.com/ibooks). Look for recent releases, such as *How to Design Questions and Tasks to Assess Student Thinking* (2014) by Susan M. Brookhart, as well as classics such as *Discipline with Dignity*, 3rd ed. (2008) by Richard L. Curwin, Allen N. Mendler, and Brian D. Mendler.

Interested in Serving on the Board?

The ASCD Nominations Committee is seeking individuals to run for a position on the Board of Directors in next year's General Membership election. The application process opened on September 1, 2014, and completed applications are due by October 31, 2014.

Visit www.ascd.org/nominations for information on the qualifications for office and the time commitment involved. (Board members serve a four-year term.) If you have questions, please contact governance manager Becky DeRigge at bderigge@ascd.org.

More on Mobile

ASCD's PD Online now has more than 75 mobile-friendly courses. The most recent and popular courses are playable on iPad and Android devices.

PD Online offers a rich library of ASCD resources compiled into modules. You'll find video clips of best practice in action and application exercises that enable you to put what you learn into practice. This self-paced professional learning opportunity includes such titles as STEM for All; Common Core and Literacy Strategies: English Language Arts; Common Core and Literacy Strategies: Mathematics; Blended Learning: An Introduction; and Teaching Argumentative Writing and Speaking, Grades 6–12.

For more information about our line-up of courses, visit http://pdo.ascd.org.

ASCD Calendar of Events

Sign up now for these upcoming conferences and Professional Development Institutes (PDIs). For details on conferences, visit www.ascd.org/conferences. For PDIs, visit www.ascd.org/institutes.

ASCD Conference on Educational Leadership (www.ascd.org/CEL)

Oct. 31–Nov. 2, 2014
Orlando, Florida

PDI: Disrupting Poverty: Turning High-Poverty Schools into High-Performing Schools

Nov. 11–12	Memphis, TN
Dec. 2–3	La Jolla, CA
Dec. 9–10	Atlanta, GA

PDI: Differentiated Instruction and the New Standards: Helping All Learners Succeed with Challenging Content

Nov. 13–14	Memphis, TN
Dec. 3–4	Long Beach, CA
Dec. 11–12	Atlanta, GA

PDI: FIT Teaching: An Introduction to the Framework for Intentional and Targeted Teaching

Nov. 11–12	Memphis, TN
Dec. 2–3	La Jolla, CA
Dec. 3–4	Long Beach, CA

PDI: Building Teachers' Capacity for Success: A Collaborative Approach for Coaches and School Leaders

Nov. 13–14	Memphis, TN
Dec. 1–2	Long Beach, CA
Dec. 4–5	La Jolla, CA
Dec. 11–12	Atlanta, GA

PDI: Essential Questions: Opening Doorways to Student Understanding

Dec. 2	Long Beach, CA
Dec. 4	La Jolla, CA
Dec. 9	Atlanta, GA

PDI: Engaged and Inspired: High-Impact Strategies to Motivate and Challenge Each Learner

Dec. 1	Long Beach, CA
Dec. 5	La Jolla, CA
Dec. 10	Atlanta, GA

70th ASCD Annual Conference and Exhibit Show (www.ascd.org/annualconference)

March 21–23, 2015
Houston, TX

EL Takeaways

SIX STRATEGIES FOR Instruction That Sticks

Rooting around in memory, trying (perhaps struggling) to remember something, is actually a great way to ensure that the memory sticks.

—*Daniel T. Willingham, p. 10*

The essential element of cooperative learning is individual accountability for all team members.

—*Robert E. Slavin, p. 22*

Teaching for understanding demands going beyond basic facts and procedures to ask, Why do we do this? Why does this make sense?

—*Marilyn Burns, p. 64*

When students have clearly articulated learning targets, they begin to see learning as growing a body of knowledge and skills, rather than completing a series of assignments.

—*Susan M. Brookhart and Connie M. Moss, p. 28*

Engaging students in literate conversations with their peers is a powerful instructional strategy for fostering reading comprehension.

—*Richard L. Allington, p. 18*

As we walk around the classroom, what we choose to focus on, how long we spend with each team or individual, and what we choose to say or not say has crucial instructional value.

—*Bradley A. Ermeling and Genevieve Graff-Ermeling, p. 55*

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Source: The collective wisdom of authors published in the October 2014 issue of *Educational Leadership*, "Instruction That Sticks" (Volume 72, Issue 2).