Improving study strategies

Exploring pedagogies for assessment

Discussion guide

Overview

This article discusses student study strategies and offers research-based practices that improve retention and outcomes, with examples, to aid implementation for teachers. It highlights what students typically do when preparing for assessment and why these study techniques are often inefficient. This article then describes four research-based study practices, with reference to supporting research, that work for students.

Key messages

- Many common study techniques used by students do not improve retention or assessment performance.
- Four research-based practices that improve memory and assessment performance are:
  - elaborative interrogation and self-evaluation
  - distributed practice
  - interleaved practice
  - practice testing.
- Retention and assessment performance are enhanced through regular and frequent formative assessment (checking for understanding) of knowledge and skills.
- These practices must be used with consideration for the individual needs of the student. The article provides a sensible caveat that informs implementation.

Usability

This article is written for school leaders and teachers to consider their beliefs and practices around study techniques for students.

The four research-based practices described in the article are practical for teachers for use in classrooms.

Strengths

The practices described in this article can be used to support students when preparing for assessment.

The article is appended with references for further exploration of practices that support independent learning and improving retention.

Notable quotes

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

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

'…study after study shows that taking a brief quiz is better for memory than rereading. The largest benefit to memory occurs when the student gets immediate corrective feedback.'

'…constant quizzing might be good for memory, but it would be detrimental to motivation.'

'…comprehension clearly requires coordinating meaning *across* sentences, and elaborative interrogation and self-explanation encourage that.'

'…study sessions should be separated by 10–20 percent of the time that you'd like to remember something.'

Discussion questions

1. What study techniques are students currently using?
2. How are we supporting students to become effective independent learners?
3. How might the strategies from this article help students prepare for internal and external assessment?

Strategies That Make Learning Last

Daniel T. Willingham

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

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.

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.

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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