Simple but Not Easy: Cognitive Principles Underlying Effective Learning

"I studied so hard for the test, yet I still did poorly. What am I doing wrong?"

The situation described by this sentence is familiar to all Baylor faculty and students. Students are frustrated by the seeming disconnect between effort and outcome. Baylor students are used to success—indeed, they are admitted to Baylor *because* of their academic success. Furthermore, most are not afraid to work hard, but they are accustomed to efforts being rewarded with better performance.

Most students implicitly adopt a view that equates expected performance with time spent studying. Better performance, then, simply means more study time. It's not an unreasonable assumption, and it's not entirely false. All other things being equal, increased study time does lead to better performance. As is the case with almost every statement beginning with the phrase "all other things being equal," all other things are almost never equal. In the past few decades, researchers in the psychological sciences have confirmed that all studying is not equal; some kinds of studying are considerable more effective than others.

I have developed a set of study tips that I distribute to any student (and faculty member) who asks. Rather than reproducing that list here, though, I want to identify several key principles that underlie this advice. The precise manner in which this advice is implemented matters little, and student can often modify their existing study habits to incorporate these insights.

Two caveats. First, while I can offer advice with respect to what works, I can't necessarily make it easy. Students often make costs-benefits judgments regarding time and effort: *How much effort is required to make an A? You expect me to do all that?* So, rather than telling students, "this is what you *should* do," I usually express it like this: "when I was a student, I wanted to make an A in every class (which didn't happen, by the way). This is the advice that I would give to the student who wanted to make an A."

Second, cognitive effort is generally aversive. Any form of complex cognitive learning demands deliberate, conscious effort. Unfortunately, as Daniel Kahneman , the Nobel Prize-winning psychologist, point outs, we don't like doing this. Kahneman {Kahneman, 2011 #6583} distinguished between "System 1" and "System 2" processing. System 1 processing is fast, effortless, and non-conscious: think how easily you recognize the voice of someone you know, or apply the brakes as needed during routine driving. System 2, by contrast, is deliberate, resource-consuming, and relatively slow: think about multiplying 18 * 22, for example. Effective studying relies on System 2, but, as

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Kahneman puts it, "System 2 is lazy." This is true not just of students, but of faculty as well. (Don't think it applies to you? How much do you dread grading research papers?). I will rely on Kahneman's framework to offer suggestions.

With those caveats in mind, here are general principles of effective college learning, followed by brief explanations.

1. Rote memorization is hard and inefficient.

We are designed to understand and comprehend things, not to memorize them. Students should pursue strategies that minimize role memorization. Sometimes we have no choice. We have to memorize things like foreign language vocabulary, or elements in the periodic table. If this is the case, then break memorization sessions up into many smaller trials—go over the definitions 3 or 4 times a day, 5-10 minutes each.

2. Do things while you study that cannot be done automatically.

Because System 2 is lazy, we often rely on the shortcuts of System 1 instead. For example, rather than trying to answer sample essay questions provided before a test, we may superficially review the concepts in the question to see whether they look familiar. Consider a sample question that says, "compare and contrast the national banking policies advocated by Thomas Jefferson and Alexander Hamilton." We've heard of both Jefferson and Hamilton, even seen their pictures on money. Their names and some simple information about them come readily to mind. As a result, we may well have a sense that this is a question we can answer, assume we know the material, and feel confident moving on to the next subject.

In reality, we've performed a cognitive sleight of hand. Since a real answer to the question involves deliberate and effortful System 2 work, we unconsciously changed the question to "do these names look familiar?" System 1 is very good at answering this question, and in this case does so affirmatively. We may discover that we really don't know the answer when we attempt to write an answer on the test.

We have lots of others ways to study "automatically:" highlight while we read, underline passages in the text, look over notes that we took in class. I always ask students, "are you the kind of reader who is so good at highlighting that you can do it almost without thinking?" If they say yes, then they have reached the point where that activity is no longer doing any good.

What to do? I encourage students, when they are studying a difficult concept, to attempt to explain it to someone. See if they can say it *out loud* as if they were lecturing on the topic. Or, if

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highlighting while reading is too automatic, I encourage them to summarize a passage from the text in their own words. If they get good at that, I ask them to summarize it in their own words *from memory*. These things are not easy, and they will take time and effort. Students may find that they can do this only for a few hours at a stretch. That's fine; take a break. Two hours of intentional, difficult studying is worth 3 times as much shallow studying.

4. Don't mistake preparation time (or participation in a study group) for actual study time.

Some students spend a great deal on tasks that appear to be helpful: preparing notecards, typing lecture notes, participating in study groups. Theses shouldn't be considered as time spend "studying." Making notecards, for example, is *preparation* for studying, not actual studying. Likewise, underlining a critical passage in a journal article means you *need* to understand it, but it doesn't mean you *do* understand it.

Study groups, where students get together in self-directed ways, are much more fun than studying alone. Students can talk with people they know and like, meet new friend, and flirt with the cute girl (or guy) who sits in the back row. Unfortunately, none of these helps us learn the material. Students might have spent an entire afternoon with a group from their premed biology class, and derived no (academic) benefit from it whatsoever. As a general rule, students benefit from studying only to the extent that they do the work—if someone else generates a study guide, summarizes an article, or passes along lecture notes, the recipient derives little benefit.

5. Testing improves learning more than studying.

Educators have long considered testing to be a form of assessment— a way to find out what an individual knows. One of the more surprising discoveries of the past ten years has been the realization that testing is more than just assessment. Testing is a highly effective way to improve student learning. Testing is such a powerful learning tool that a student with a fixed amount of preparation time would be well advised to take time away from studying to test him or herself. Say a student has one hour to learn new material. Students who study for one hour do worse than those who spend 30 minutes studying and 30 minutes testing.

This works only if students test themselves "honestly." That is, there is no benefit from reading a question and then looking up the answer—the students must test generate the answer (or pick the correct alternative) themselves. (The same is true of classroom time, too. Time spent on a short daily quiz is more beneficial than using the same time for lecture).

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6. Study in relatively short but frequent sessions, rather than trying to learn too much information at a single study session

Most of us, in high school, could get away with cramming before a test. This gets increasingly difficult in college, because (a) the material is more difficult; (b) there is more material to be learned, and (c) you've got many classes to study for, and tests tend to fall on the same general dates.

You will be much better off if you can study material from all your classes each day, rather than designating one or two days a week for "English" or "Psychology." Furthermore, cramming in the day or two before a test does not give you enough time to remediate any shortcomings—you don't have time to get answers to your questions, or to have professors explain difficult concepts to you in a different way.

7. Don't be fooled by the "illusion of knowing."

Psychologists have documented a phenomenon known as "the illusion of knowing," a pervasive problem in our ability to monitor our learning. Students believe they understand something when they really don't. The most common ways this manifests itself are:

(1) Mistaking ease of reading for comprehension. Students believe that because they understood what they read, they have mastered it. Especially in difficult courses with well-written material, one can follow the author's writing without difficulty—understanding what someone said is not the same as remembering it. Close your book and try to summarize from memory. If you can't you really haven't learned it.

(2) Reading answers rather then generating them. Some student take sample tests by reading a question, peeking at the answer, and then thinking, "oh, yeah, I would have gotten that one."

(3) Using superficial cues to assess difficulty. We should judge difficulty of learning by the underlying content. We don't. Instead, we use shallow cues—simple language, boldfaced words, highlighted text, or the presence of "advanced organizers" like outlines—to infer readability. Ironically, textbooks with key terms set with clear boxes, important words highlighted, even the presence of a demarcated topic sentences can lead to this overconfidence.

(4) Evaluating one's memory too soon after studying. Take a break between the time of study and the time you test yourself. That way, our self-test will require retrieval of information from long-term (not short-term) memory.

As I warned, these principles may be simple, but implementing them is not easy. Professor can encourage some of these practices with simple changes (daily or weekly quizzes, for example). Even in

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cases where students fail to take advantage of these practices, they are likely to be less frustrated when they compare what they have done to prepare to what they *could* have done.

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