Self-Testing: Student Tip Sheet

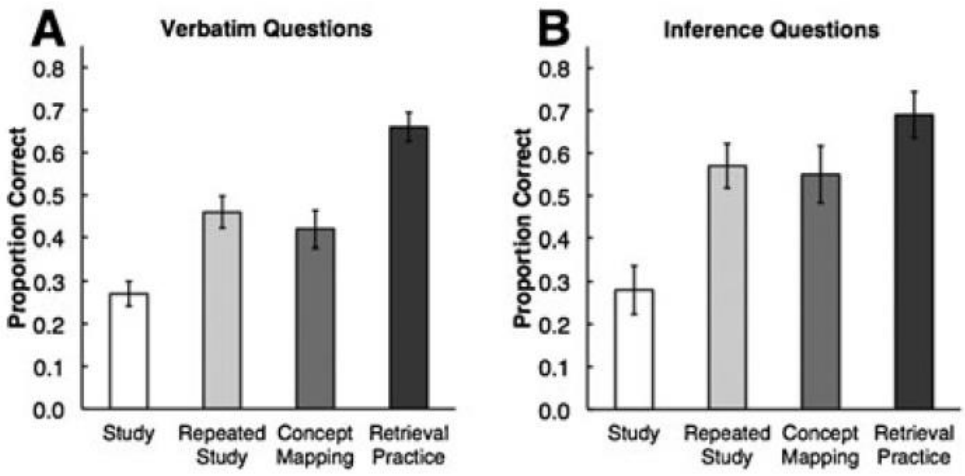
PART 1: What is self-testing and how does it work?

Self-testing is a learning strategy in which you first study material and then try to recall as much as you can, or answer specific questions, without looking back at the material. An example of self-testing is reading a passage from your text, putting it aside, and then writing down as much as you can remember from the passage. Another example is using flashcards to test yourself on important course concepts.

Abundant research has found that self-testing is a potent learning strategy (Dunlosky, Rawson, Marsh, Nathan & Willingham, 2013). To illustrate, in one study researchers compared the test scores of students in four study conditions. In the learning phase of the study, each group studied the material differently.

- Group 1 Study: Students read the material one time.
- Group 2 Repeated study: Students read the material four times.
- Group 3 Concept mapping: Students read the material one time and then made a concept map of it.
- Group 4 Retrieval practice: This involved self-testing. Students read the material one time and then wrote down everything they could remember without looking back at the information.

One week after the learning/study session students took a test on the material. As shown in the graphs below, the Retrieval Practice (self-test) group outperformed the other groups on questions of verbatim factual information as well as inference questions that involved drawing inferences and conclusions (Karpicke & Blunt, 2011).



Source: Karpicke, J. D., & Blunt, J. R. (2011). Retrieval practice produces more learning than elaborative studying with concept mapping. Science, 331, 772–775. http://dx.doi.org/10.1126/science.1199327

Surprised that self-testing leads to better learning than repeated rereading? It turns out that self-testing is very effective and rereading is not. Self-testing is an effective learning strategy for two reasons:

1. First, when you try to recall information you have been learning you make new connections and associations that will help you recall it in the future. Bringing information to mind

strengthens the memory and increases the chances you can recall it in the future. Engaging in the process of retrieval produces learning. As researchers have said,

> *Every time we retrieve knowledge, that knowledge is altered, and the ability to reconstruct that knowledge again in the future is enhanced*.
>
> Karpicke & Grimaldi, 2012

In retrieving information from memory, you form new associations and connections to the material. With additional retrieval attempts, it becomes easier to recall the information.

2. Second, when you can't recall information, it is a clear signal that you don't know it and need to go back and review it. Self-testing gives you feedback about what you do and do not know, information you can use to alter your study. After a disappointing test grade, students often tell their instructor, "I thought I knew this." However, there is only one accurate way to judge whether you know something – test yourself on it. If you can't produce the answer, you don't know it. Self-testing enables you to better judge what you know and don't know. Then you can go back and fill in the missing pieces.

Why is rereading less effective? Studies show that rereading material one time does improve learning. But additional rereading produces little improvement (Callender & McDaniel, 2018). Rereading makes the material more familiar. In fact, familiarity may lead you to think you actually know the material, sometimes called the "illusion of knowing" (Soderstrom & Bjork, 2014). But familiarity with the material is not equivalent to knowing it. Ironically, you may invest less mental effort in rereading because you believe you know it. In this way, rereading tends to be superficial repetition of the material.

Note that rereading can be a very productive learning experience when an individual ponders a text, works out new meanings, monitors comprehension and backtracks to gain better understanding and so forth. But this kind of close, probing reading is not the typical way students read homework assignments. More commonly students are guided by the belief that repetition will produce adequate learning.

Although self-testing is an effective learning strategy, students tend to dislike it because it seems

1. harder than rereading and highlighting the material. Testing yourself requires extra mental effort and even a bit of struggle to recall what you learned. This *is* more difficult than simply rereading the information.
2. less effective. If you read something one time and write down what you remember, you may be disappointed in how little you recall. That experience leads students to conclude that self-testing is ineffective, and they stop using it. However, the research is quite convincing, repeated self-testing over the material is much more effective than rereading it.

PART 2: How to do self-testing.
Self-testing can be done in many different ways to enhance your learning. Here are a few examples:

When reading an assignment. Read a segment of assigned material, a paragraph or an entire page. Then stop, put the material aside and try to write down everything you remember from what you just read. This will seem difficult and you probably won't remember everything or even understand everything. But that's OK; the point is to try to remember it. You will be strengthening your memory for everything you are able to recall, and that information will be easier to remember again later. Go through the entire assignment, reading and then trying to remember the information from each part. Research has shown that this type of practice testing is superior to simply rereading the material, and even better than reading and taking notes on the material.

Here is another tip. If you decide to reread an assignment, do it 1-2 days after the first reading. But before you reread, take a few minutes to test yourself by trying to remember the information from the assignment. Jot down everything you remember. Then read the assignment again, using the self-testing approach. When you are done, use your answers to identify gaps in your knowledge and understanding of the material. You can then go back and review the chapter and work on material you don't yet know.

This self testing approach will probably seem more difficult than simply rereading or taking notes from the reading assignment. And, it is. You are using your mind in a different way to think about the subject matter. Rereading and note taking seem easier because you don't have to think deeply about the meaning of the material or try to remember it. Although practice testing feels harder, on the plus side, it is more effective and takes less time than rereading or reading and note-taking.

At the end of class. As soon as you can after class, take five minutes to write down the major points from the class period, and then try to recall as much as you can under each major point. This is an excellent way to consolidate what you were trying to learn in class. Then later when you review your class notes, handouts, etc., you can refer back to your answers to see where you need to review and add to your understanding.

Answer practice questions. If you use a textbook that has questions at the end of each chapter, get in the habit of trying to answer them. Read the chapter and then answer the questions as best you can. Don't look back at the answers in the book. You may not be able to answer all of them well, but that's OK. Trying to answer the questions will improve your memory for the material. You can then go back and review the chapter to work on the gaps in your answers.

Answer Study Guide Questions. A study guide from the instructor is a gift; use it! If the study guide includes practice test questions – use them!! An effective approach is to:

1. Review the study guide questions for the assigned reading first.
2. Read the assignment.
3. Answer the questions without looking back at the material. Don't answer the questions as you encounter them in the text. Don't look up the answers or look back at the book! Try to answer the questions as best you can first.

4. Check and revise your answers. Go back and compare your answers to the material and extend and refine your answers.
5. The next time you read the assignment, review your answers and then study the material strategically – focusing on gaps in your understanding and weak spots in your answers.

Make your own practice questions/quizzes. Initially, read and test yourself over new material (this type of test is called "free recall"). Then while the material is still fresh, go back and write a few questions to use as practice quiz questions. Testing yourself with specific questions is known as "cued recall," because the question itself reminds you of the topics to be remembered. Use your practice questions to self-test each time you study. Cued recall questions make self-testing a bit easier than trying to remember and write down everything you remember as in free recall.

Flashcards. Research shows that many college students use flashcards to learn specific ideas, concepts, formulas, or terminology. Flashcards can be a potent form of self-testing, but only if you use them appropriately. To maximize the effectiveness of flashcards, do these things:

1. Read the course material first before making flashcards. Reading first is essential because it helps you
    a. develop an initial understanding of the material, which is necessary to write good questions.
    b. differentiate important concepts from less important details. Then you can write questions over key concepts rather than information that is unlikely to be on the course exam. For additional information about how to write high quality flashcard questions, see Research-based Guidelines for Using Flashcards
2. Each time you look at a card try to answer the question before looking at the answer. Try hard and don't look at the answer too soon.
3. If you answer correctly, do *not* drop the card from further study. Keep it in the deck. Just because you answer correctly one time does not mean you will know the answer when you take a future test over the material. A good rule of thumb is to answer the question three times correctly in each study session, and include the question in three different study sessions. This means you should answer the question correctly 9 times (three times on three different occasions) before dropping the card from further study.
4. Spread out your use of the flashcards. It is a lot more effective to self-test with flashcards in different study sessions spread out over a period of a few days.
5. Practice the concepts during the entire semester to ensure that you know the material so well you won't need to cram for the final exam. Seriously, this is an excellent and efficient way to study for the final exam in small doses throughout the semester.

Remember:

1. Try to recall the flash card answer before looking at the answer on the card. If you don't really test yourself, then using flashcards is no more effective than just skimming the material.
2. Don't drop a card from study too soon. You should be able to answer the card correctly at several different study sessions. Think of it this way. You may be able to answer the card correctly today—but can you answer it correctly in several days when it is on an exam. The best way to protect yourself from forgetting, is by testing yourself over the material at several

different times. Remember the rule of thumb—recall the answer nine times correctly, three times on three different occasions.

Be aware of three limitations related to flashcards:

1. Flashcards will help you learn the information on the card, but may not help you learn concepts that are not part of your flashcard questions.
2. Flashcards may be ineffective if you do not *understand* the material. If you don't understand the material, try a different strategy like self-explanation to develop a better grasp of the concepts. Once you have a better understanding, use flashcards to help consolidate and remember what you learn.
3. Flashcards are unlikely to help you learn to apply the material. If your course exams involve solving problems, applying material to new situations, analyzing or evaluating ideas, flash cards won't be much help. Instead you need to use practice tests in which you practice applying the material, solving problems, analyzing or evaluating ideas.

Summary

Self-testing is a potent learning strategy. It is based on the idea that trying to remember what one has studied actually improves learning and memory for the material. Self-testing is also effective because it helps students identify gaps in their learning, which is important for self-correction.

Students can use self-testing in a number of ways:

- during reading assignments
- at the end of class
- answering review questions at the end of text chapters and study guide questions from the instructor
- making their own practice tests, sometimes with the aid of flashcards.

Key points about using self-testing:

- Self-testing requires different mental effort than rote learning strategies such as rereading, highlighting and memorization. Self-testing may seem harder and less effective, but the payoff in terms of long-term learning is much greater.
- Be aware that deep, long lasting learning is difficult compared to temporary learning that evaporates soon after taking a test.
- Develop a habit of trying to answer practice questions or flashcards thoroughly before checking the answer. A little struggle in trying to recall information is beneficial for long lasting learning.
- Develop practice questions that align with and focus on important course concepts and ideas.
- Test yourself multiple times in different study sessions on the same material. Separate study sessions by 1-2 days rather than trying to cram study into one long session. To improve long-term learning, spaced practice is much more effective than cramming.