



How People Learn: Common Beliefs vs. Research

Most people believe that repeated exposure to material, such as “going over” notes, “re-reading” are the main and most important ways to learn and “absorb” information. In fact, research shows that memorizing in this way has significant shortcomings. Such methods are not only highly time-consuming and less than optimally effective, they are often rather boring. There are not only more effective and efficient methods of learning, but alternative approaches are often more engaging, interesting, and enjoyable.

You may be skeptical of this research because you have done a lot of review in the past, and “it’s worked”. Let’s take a moment to consider this further. To the extent that repeatedly reviewing materials (rehearsal) is effective as a way to deepen our knowledge (vs. merely solidifying it), it may be a result of our processing or acting on what we are learning as we rehearse. For instance, when we “go over” lecture notes we may be doing more mentally than simply reviewing what we’ve written previously. We may be making new connections among concepts or between concepts and examples (and perhaps drawing arrows or adding notes), we may recognize the significance of some information we hadn’t grasped before, we may anticipate how we will be tested, or we might ask ourselves new questions about the material and thus think about it in new ways. Without this analysis we might think that merely “reviewing” was crucial to our learning, but research tells us (and perhaps your own reflections too) that it is these active, often challenging mental processes that are what make reviewing beneficial. But note, one can mindlessly rehearse material, simply looking at it again with little, active mental processing resulting in little deepening of our knowledge despite considerable time invested. So, it’s better to study in ways other than rehearsal to reliably and efficiently master new material.

Additionally, most of us conclude that if we are learning easily, we are learning well. Recent research (some done here at Princeton), however, clearly demonstrates that effortful learning usually signals not only deeper learning, but more durable long-lasting knowledge. It’s analogous to weight training. Lifting heavier weights which require more effort will build more muscle in much the same way investing more effort in grappling with new information builds stronger, deeper knowledge. So, perhaps surprisingly, sometimes we want to make our learning harder, in order to make it more effective and efficient. It’s easy, for instance, to “do” flashcards, re-read highlighted text, and re-copy notes and the like. Whereas, identifying gaps in our knowledge and filling them, practicing applying our knowledge or skills, and synthesizing what we’ve learned are far more challenging.

Making learning difficult in strategic and **desirable** ways will enhance retention, retrieval, and transfer of knowledge. [Desirable difficulties](#) are those which evoke or induce mental processes which strengthen encoding and facilitate retrieval by virtue of making the taking in and processing of information more effortful. For instance, we recognize that teaching someone else that which we are ourselves striving to learn is a highly effective way for deepening our understanding and making our knowledge more retrievable in the future. But WHY is it effective? The theory is that doing so requires that when explaining we instantiate or “reboot” our knowledge structures into working memory, we must elaborate on new information using

our own long-term knowledge, we often make new linkages or connections among nodes of knowledge (e.g. topics) when explaining, and we think under new circumstances in new ways when interacting with others in the role of “teacher”. That’s not to say that teaching others in, for instance, a study group, is the only way to incorporate desirable difficulties into your self-directed learning; there are many other ways to do so.

Here are some general learning principles to help you allocate your time and effort efficiently and incorporate desirable difficulties into your approach to learning (processing), studying (solidifying), and exam preparation (practice). You can also use these principles, drawn largely from the work of [Robert Bjork’s research lab](#), to examine your current approach to learning in order to assess its efficiency. If you feel you are not being efficient, try using these principles to re-think your academic approach with a [learning consultant](#). Some of these principles are counter-intuitive, so it can be helpful to [meet](#) with a learning consultant to brainstorm ways to implement them that work for you.

1. Allocate your **attention** efficiently.
 - a. Focus on one task only, don’t divide your attention in ways that are hard, but unhelpful. Instead, challenge yourself to think deeply, conceptually about what you are studying.
 - b. Align your purposes to the design of the course by knowing professors’ goals. Get clear about what knowledge and skills your instructors want students to learn, and identify difficult aspects of the course for extra attention and study.
2. **Organize** information that you are trying to learn using powerful frameworks/conceptual categories like those used by experts (e.g. your professor) in the field.
 - a. Identify the models, organizational patterns, and other conceptual tools used by your professor and use them yourself to organize new information.
 - b. Ask: “How does my professor think about this topic, field, problem, etc.?” Intentionally experiment with thinking “like an expert”.
3. Actively **elaborate** on and connect what you are learning to what you know. Think of your own examples to illustrate and explore concepts introduced in the course.
4. To make your knowledge more durable, **vary** your studying in terms of locations, situations (alone, with others), modalities (oral, visual, verbal).
5. **Space** your studying for a course over several episodes; **interleave** your studying of different courses, minimize studying similar materials for long uninterrupted periods in order to enhance your memory of it.
6. **Draw** a representation (image) of the information you are learning. Make charts that organize information, sketch out processes, create flow charts, make a mind map of key concepts and their relations to clarify your understanding.
7. **Anticipate** subsequent study and practice (e.g. exam prep) and put information into an efficiently “studyable” form. For example, take notes in a format that helps you do problem sets and makes exam prep easier.