

The Science of Successful Learning

GENERAL PRINCIPLES

- I. Learning requires time, work, and motivation; learning is deeper and more meaningful when it requires effort.
- II. Though reading and reviewing notes (or flashcards) is by far the most common and preferred study methods, this is one of the least effective methods when it comes to retention. *Active learning* leads to better encoding.
- III. People often are under the illusion that once a student can recall facts perfectly, he/she has achieved mastery. In reality, long-term retention is best achieved when students understand concepts. To this end, students should be pushed to explain concepts in their own words.
- IV. Beginning students do not know what they do not know, and they consistently overestimate the quality of their work and answers. Further, beginning students are not skilled at evaluating their own (or their peers') work. Thus, it is important that instructors provide students with effective feedback early and often.
- V. Beginning teachers continually overestimate how much learning students attain during any one lesson. It is essential that instructors focus on "need to know" information. It is also essential that instructors consistently assess all students for their levels of understanding throughout a lecture and a course.

WHAT WORKS? The following bullet-point list identifies methods and behaviors that have been shown to improve retention. Details about what each bullet point means, including how to apply this information on a course, are included on the following pages.

- 1) Students learn better when they are required to retrieve facts on their own (and are not allowed to use aids). Forcing recall (versus choosing a right answer from a list) helps strengthen neural pathways.
- 2) Spaced learning improves retention. That is, introducing material, and then reviewing it or practicing it again hours, days, or weeks later, improves learning and retention.
- 3) Deliberate practice is by far the best tool for improving performance.
- 4) Making mistakes (or allowing mistakes) helps build neural bridges, as long as students are allowed to re-do. (This is similar to No. 3, deliberate practice.)
- 5) Receiving information via a non-preferred learning style enhances long-term retention.
- 6) Conceptual learning leads to better long-term retention. Additionally, information is assimilated best then students clearly understand *why* information is important and how it applies to their personal situations
- 7) Requiring students to "say things out loud" and describe concepts in their own words helps enhance understanding and long-term retention.
- 8) Field performance rarely exceeds the level obtained during practice. Consequently, it is important to hold students to exacting standards throughout all practice sessions.

DETAILED DESCRIPTION OF THE BULLET-POINT TECHNIQUES, INCLUDING IDEAS ON HOW THIS INFORMATION CAN BE APPLIED IN CLASS

- 1) Students learn better when they are required to retrieve facts on their own (and are not allowed to use aids). Forcing recall (versus choosing a right answer from a list) helps strengthen neural pathways.**

When students are introduced to a new topic, they initially struggle to recall details from memory. At the beginning, it is okay for them to use prompts, flashcards, or other forms of assistance to help with memorization. As soon as possible, however, students should be asked to try to answer questions without using any aids. Other students should not yell out correct answers or provide hints.

Waiting for students to be able to pull correct answers from memory takes time, but it is important to allow this to happen. Recalling information from memory works well to build neuropathways, and this step can help push students from(Bloom's) "familiarity" through "recall."

- 2) Spaced learning improves retention. That is, introducing material, and then reviewing it or practicing it again hours, days, or weeks later, improves learning and retention.**

Sometimes information is taught/learned "all at once;" i.e., a topic is taught from beginning to end, within a brief period. However, unless students revisit this topic later, almost always there is rapid attrition. In other words, when information is taught all at once, retention is poor.

Spaced learning (or spaced practice) requires the following: Once new information is presented, instructors should allow time to pass and then revisit the information. There is compelling evidence that spaced learning improves long-term retention. Generally, the longer the gap, the better the results.

It is difficult to use spaced-learning techniques in a two-day WFA, but it is relatively easy to integrate this concept into longer courses. An effortless way to incorporate spaced learning into the classroom is to NOT follow a lecture with a drill on the same topic. For instance, when you finish with the anaphylaxis lecture, do not run an anaphylaxis drill. Instead, run a drill that emphasizes a different topic (such as trauma, spine assessment, or asthma). Follow up by running an anaphylaxis drill the next day.

The key thing to remember is that learning is most effective when you present some information, wait, and then revisit that information later.

- 3) Deliberate practice is by far the best tool for improving performance.**

Practice is important, but deliberate practice is *by far* the most effective tool for improving performance (as noted in nearly all research). Simply spending time performing a skill does not automatically enhance one's level of performance. Just because students are "practicing" a skill, without direction and feedback, there is no guarantee that improvement will follow. In fact, without supervision and feedback, students might simply be solidifying bad habits.

In addition, research shows that varied practice helps students with knowledge integration. (In other words, myriad techniques should be used whenever possible.) Varied practice allows students to better assimilate material and reflect on connections between topics.

The following are examples of how you can incorporate deliberate and varied practice into your courses:

Quizzes. Quizzes can be an incredibly effective teaching tool. They are effective for helping students practice their cognitive skills; they are useful in helping instructors assess student understanding; and well-written quizzes can provide students with an “ideal” of what academic success looks like. But to use quizzes most effectively, they must be well written. Questions should align with the students’ learning progression. And students should receive feedback on their work.

Early in the course, quiz questions should emphasize recall. For example, a quiz might focus on factual items that are considered “need to know.” Students might be required to list normal vitals, or students might be asked to list the types of shock.

As a course progresses, quiz questions should focus more on concepts, and students should be required to explain concepts in their own words. For instance, students might be asked to describe what is happening in the body during volume shock, and students might be asked to explain why the body compensates as it does. Students might be asked to explain why a specific treatment option does or does not make sense, or student might be asked to justify their answers.

When using quizzes, it is important to provide feedback. If possible, it is best to grade and return all quizzes; however, it also works to type a well-written key and hang it in the classroom.

Drills and scenarios. Drills and scenarios offer myriad options for letting students practice. However, unless a drill is well-thought-out, and unless a drill includes feedback, it is unlikely that students will progress as rapidly as they could.

Deliberate practice requires that instructors have a clear understanding of what it is they are trying to get the students to achieve, and everyone (instructors and students) should have a clear idea of what “success” looks like. (Is the goal for students to accurately assess and anticipate problems? Or is the goal to build a quality splint?) At the end of the drill, students should receive feedback on their work.

Further, instructors should understand that simple drills often work best when it comes to skill development. Just as a beginning basketball player benefits greatly from basic drills—such as dribbling and passing—before he or she is allowed to take part in a scrimmage, it is generally best if WFR students are allowed to practice basic skills before they move on to scenarios. For example, students should be allowed practice skills such as head to toe examinations, spine assessments, and wound cleaning, in isolation, before these skills are incorporated into a more complex exercise.

During or following a drill, instructors should provide feedback. Instructor should remember that instructor-led feedback (versus peer feedback) is always more effective when students are learning and practicing new skills.

Scenarios offer the chance to practice many skills in an abbreviated period, but they are not a particularly effective tool for developing good habits. Instead, once students achieve basic proficiency, scenarios can be used to help students practice their skills under potentially realistic and challenging settings. A scenario is a highly effective teaching method, but it is best to use a scenario only after fundamental skills are obtained and practiced.

SOAP notes. Though WFA students are not expected to be able to write polished SOAP notes, WFR students are expected to acquire this skill. Unfortunately, many students struggle when it comes to writing good SOAP notes. This might be because their instructors did not teach the topic well or did not provide a good demo on how to write good notes, it might be because students did not get much time to practice writing notes, or it might be because students were given little feedback on their work.

To help, instructors should consider handing out a well-written case study to the students along with an “ideal” SOAP note (that you have written) as a demo. The demo provides a template that students should follow. The instructor can then hand out a second case study and ask students to write their own SOAP notes, trying to come as close as possible to the form and style that you provided in the demo.

If possible, an instructor should grade the notes and provide written feedback. To save time, an instructor can hang a “key” in class. The key would be an “ideal” SOAP note that the instructor wrote for that second case study. Students then can compare their SOAP notes to the key.

When beginning students are given a problem to solve and they work individually, learning is reduced. When students work in small groups, however, the same problem-solving exercise actually enhances learning. Thus, it can be beneficial to have students initially work in teams of two or three. Instructors might consider having students work in teams to complete quizzes, skills, and SOAP notes at the beginning of a class, but as students progress, they should be asked to work alone, when possible.

4) Making mistakes (or allowing mistakes) helps build neural bridges, as long as students are allowed to re-do. (This is similar to No. 3, deliberate practice.)

Instructors do not always know if they should intervene when they see students making mistakes. Is it best to step in and correct the error? Or will students learn best if they figure things out themselves? Research shows that students learn best when they make mistakes, are given feedback, and then are given a chance to correct those mistakes. When this sequence occurs, the learning is encoded even better than if the students never made the mistake in the first place.

In other words, the following sequence is ideal: An instructor should present a skill and then demo that skill; students should be allowed to practice the skill without interruption; at the end of the drill, the instructor should provide each student with specific feedback. If the student did perform perfectly, then the students should then be given time to re-do the exact same skill. Although time constraints do not always allow for this, instructors should keep in mind that this sequence provides the best learning.

If time does not allow for a re-do, then the next best tactic is for instructors to allow students to make “partial” mistakes. That is, an instructor might notice that a student has a mistake. The instructor should stop the student before he/she finishes the drill. The instructor should provide feedback on that mistake, and the student can incorporate the feedback and correct the error.

The least effect teaching methods include the following: allowing students to make mistakes without providing any feedback; providing feedback to a group but not to individuals; allowing beginning students to critique each other’s work; and/or providing feedback at the end of a drill but then not allowing students to re-do.

5) Receiving information via a non-preferred learning style enhances long-term retention.

Using non-preferred learning styles is counterintuitive to most people. However, current research shows that students who use their preferred styles learn quickly, but then they also lose the information quickly: their retention is poor. To “make things stick,” research shows that retention is better when effort is required. Using non-preferred learning styles takes more works and results in better retention.

This does not suggest that instructors avoid preferred learning styles. But to apply this concept to the classroom, instructors are encouraged to try to use as many teaching methods as possible, regardless of student preferences. Do not be coerced into focusing on only one or two styles just because your audience does not like the alternatives.

6) Conceptual learning leads to better long-term retention. Additionally, information is assimilated best then students clearly understand why information is important and how it applies to their personal situations

Students almost always encode information better when they are told “why” something works the way it does as well, and they clearly understand why it is important to learn the material. Although most instructors (when interviewed) think they do this, research shows that students often report that the relevancy of material is not always clear.

To enhance learning, instructors should develop a habit of including statements such as, “here is why this important should be important to you,” and this should be done consistently. The “why” should be convincing, justifiable, and it should make sense to the students.

7) Requiring students to “say things out loud” and describe concepts in their own words helps enhance understanding and long-term retention.

Research has shown that when you say things out loud (versus listening to someone provide a correct answer, reading silently, or reviewing notes or flashcards silently), encoding is enhanced. Consequently, instructors should ask all their students to say things out loud as often as possible. Examples of how to do this include the following: use the Cold Call method, plus Wait Time, to ensure that all students get the chance to talk; limit how much time you talk during reviews; encourage students to talk out loud when reviewing their notes or flashcards (outside of class or during evening study sessions); create

opportunities for groups to recite course information collectively (e.g., ask students to recite each word of the STOPEATS acronym out loud, as a group).

8) Field performance rarely exceeds the level obtained during practice. Consequently, it is important to hold students to exacting standards throughout all practice sessions.

Research shows that when people perform under pressure, the quality of their work goes down. It is rare that people will perform better in field situations than they perform during drills.

During drills, WMA students often are tempted to “cut corners” to save time and energy. Students often say, for example, “If this was for real ...” which is followed by something like, “I would have made the splint neater,” or, “I would have taken off his boots.” No research bears this out.

In fact, students are far more likely to do what they practice; they are not likely to do what they say. For example, when students are required to feed and hydrate patients during a scenario (and not simply pretend to do so), those same students are more likely to feed and hydrate patients in a real emergency.

Instructors should keep in mind that every time a student performs a skill, the skill becomes more encoded. If the skill is practiced poorly, then students will encode poor performance and they will likely perform poorly in an emergency. If, on the other hand, students are required to “practice perfect,” they are more likely to perform well in a crisis.

References

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