

Random Thoughts . . .

HOW LEARNING WORKS

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In the last few decades, cognitive scientists have made significant progress toward understanding how and under what conditions the brain takes in and stores information—or in other words, what facilitates and hinders learning. Few university instructors are taught any cognitive science before or after they join a faculty, however, and they consequently default to teaching the way they were taught, regularly doing things that interfere with learning and failing to do things that promote it. Fortunately, a growing number of books now exist that translate the often dense jargon of brain research to language instructors in any field can read, understand, and apply. A particularly good recent translation is *How Learning Works*,* a well-written formulation of seven instructional principles that come directly from cognitive research and their implications for teaching practice. Here are some highlights.

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Principle P1: Students' prior knowledge can help or hinder learning. Most information taken in through the senses either never enters our consciousness or is quickly filtered out and lost, with only a relatively small percentage being retained in long-term memory. The odds that students will retain new information increase if the information is explicitly linked to their previous knowledge. Also, students often come to our courses with misconceptions about what we are teaching. If we fail to convince them otherwise, they may learn to parrot our statements of the concepts on exams but their faith in the misconceptions will remain unshaken.

Principle P2: How students organize knowledge influences how they learn and apply what they know. A big difference between experts and novices is that experts have organized their knowledge into patterns and novices have not. When experts encounter a new problem, their mental organization enables them to quickly adopt an effective strategy for problems of that type, while novices are more likely to flounder through randomly selected strategies.

Principle P3: Students' motivation determines, directs, and sustains what they do to learn. Motivation to learn in a course increases if students believe the course is about things they care about and skills they will need, and if they think they have a good chance to succeed.

Principle P4: To develop mastery, students must acquire component skills, practice integrating them, and know when to apply what they have learned.

Principle P5: Goal-directed practice coupled with targeted feedback enhances the quality of students' learning. Students learn problem-solving strategies and improve skills by initially attempting small tasks that require the strategies and

* Ambrose, S.A., Bridges, M.W., DiPietro, M., Lovett, M.C., & Norman, M.K. (2010). *How learning works: Seven research-based principles for smart teaching*. San Francisco: Jossey-Bass.

skills, getting feedback on their attempts, trying again with better results, and gradually moving to increasingly complex problems. Their improvement is accelerated if they fully understand the instructor's learning goals and the feedback they get is clearly related to the targeted skills.

Principle P6: Students' current level of development interacts with the social, emotional, and intellectual climate of the course to impact learning. Good courses challenge students to question and revise their conceptual understanding and beliefs on the basis of the best available evidence. Their ability to rise to that challenge depends heavily on whether the class climate is supportive (the students feel accepted and safe, even when their ideas are being challenged), chilly (they feel they are anonymous and their ideas are irrelevant or unacceptable), or hostile (they feel marginalized because of their race, gender, or beliefs, or they perceive the instructor as an adversary rather than a source of support). Students in a supportive climate are much more likely than students in chilly and hostile climates to achieve the instructor's learning goals and gain self-confidence, autonomy, and a sense of personal and professional identity.

Principle P7: To become self-directed learners, students must learn to assess the demands of the task, evaluate their own knowledge and skills, plan their approach, monitor their progress, and adjust their strategies as needed. Metacognition (self-reflection about one's learning) has repeatedly been shown to promote cognitive skill development.

The following instructional strategies collectively address all seven principles (P1–P7).

Strategy S1: Collect data about students and use it to design instruction (P1,P3). Gather information about their prior knowledge, skill levels, interests, and goals. Link material you are teaching to something they already know from previous courses or personal experience, and when possible, to something they care about. Connect abstract theories and concepts in the course to familiar real-world problems and applications. Run or simulate experiments that address common misconceptions, ask the students to predict the outcomes, and then help those who predicted incorrectly figure out why they were wrong.

Strategy S2: Be explicit about your learning goals, learning objectives, and expectations (P3,P5,P6). Make your learning goals challenging but attainable by most of the students in your class. Write detailed learning objectives that spell out what the students should be able to do (define, explain, calculate, model, critique, design,...) if they have acquired

the knowledge and skills you are trying to help them develop, and share your objectives with the students. (Putting them in study guides for exams is an effective way to get the students to pay attention to them.) Make sure your exams are clearly tied to your learning objectives, lessons, and assignments.

Strategy S3: Scaffold complex tasks (P2–P7). Teach and test at a level that is challenging but not too far above the students' current knowledge and skill levels. Identify tasks that students are likely to find difficult and construct in-class activities and assignments to provide practice and feedback in the required skills, and then move to problems that require combining the skills and broadening their range of applicability.

Strategy S4: Help students learn to function like experts (P2,P4,P7). Show them—or better, get them to create—graphic organizers and concept maps for subjects you are teaching them. Have them formulate solution strategies before beginning to work on new problems, and when they complete assignments have them reflect on what they learned and what they will do differently in the future. When you first ask them to strategize and reflect, explain why you are doing it and give several good and bad examples of both processes.

Strategy S5: Establish a supportive class climate (P3,P6). Learn and use students' names and encourage them to interact with you in and out of class. Make clear that alternative viewpoints and approaches may be challenged in your class but not disrespected. Avoid using language that could be viewed as stereotyping or disrespecting students and challenge any stereotyping or disrespectful or discriminatory language directed by any students toward classmates. Make your tests challenging but fair, test only on what you have taught, and allow enough time for most students to complete the tests and check their solutions. Collect anonymous student feedback in mid-term evaluations and investigate and respond to any complaints related to class climate.

If you are a good teacher you may be scratching your head now, wondering why we're bothering to suggest these things you already know and may have been doing for years. It's true that there's nothing novel about the recommended strategies; what is new is that besides having extensive empirical and theoretical support for them, we now know that they have solid foundations in brain science. Our hope is that the brief sampling of ideas in this column will induce you to get a copy of *How Learning Works*, find out for yourself what happens in the brain that makes the strategies work as well as they do, and use that knowledge to sharpen your implementation of the strategies and make them even more effective at promoting your students' learning and intellectual development. □

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