

Promoting Students' Ability to Retain Information and Apply it in New Situations

Research in cognitive science is starting to unravel the mechanics of how we learn in ways that can positively and productively affect how we teach. Some of this research specifically focuses on what factors contribute to our being able to remember what we've learned over time and use it in new situations – important goals we as teachers have for our students. Retaining knowledge over the long term, however, requires that we process it in such a way that we move ideas from short-term to long-term memory, and fit these new ideas in with what we already know (or think we know). Likewise, the ability to recognize the same principles and concepts at work in different contexts is not trivial, because everything that we learn tends to be packaged according to the context in which we learn it. Below is a brief summary of ideas on processes of retaining and transferring content (i.e., using it in a new setting) and possible strategies for teaching in ways that promote more lasting and transferable learning.

- **Prior knowledge** – It is much harder to “unlearn” material than to learn it the first time – misconceptions can be long-lived and highly resistant to change. Gathering feedback on what students already know early and often can help alert you as the instructor to areas that will need more attention.
- **Re-representation of information** – Reworking ideas from verbal to written words and words to pictures forces us to re-conceptualize information and creates multifaceted memories that are more easily accessed. Having students write out explanations in words as they solve numerical problems, create graphs and charts or diagrams from verbal information, or use images as well as text to discuss ideas, compels students to process information in ways that go beyond mechanical manipulations.
- **Interpretative work** – Only a certain amount of processing of information occurs in response to hearing information presented. Requiring students to speak and write about new ideas, solve and talk about conceptual problems, and in other ways actively engage with new thoughts enhances learning. What students do in classes matters far more than what instructors do.
- **Practice at retrieval** – Generating the same information in different applications with minimal cues repeatedly over time is one of the most important ways to promote facility in use of knowledge. Using Socratic questioning or having students teach each other obliges students to recall information under different circumstances and promotes long-term memory.
- **Remembering helps remembering** – Remembering answers to certain questions helps students recall that information the next time, but may cause “selective forgetting” of information that they are not asked to recall, especially if that information was only newly learned. For example, having students remember fairly trivial information for exams thinking that this practice reinforces the underlying major principles is counterproductive – the trivia is remembered and the principle forgotten. One way around this dilemma is to design a variety of assignments that address key ideas from your course.
- **Less is more** – Given the deep processing required for real understanding to occur, instructors are well-advised to balance how much information they want students to know with how well they want them to know it.

Adapted from Diane Halpern and Milton Hakel, “Applying the science of learning to the university and beyond,” *Change*, Vol. 35, 2003, pp 2-13.