Using Learning Science to Make Learning Durable

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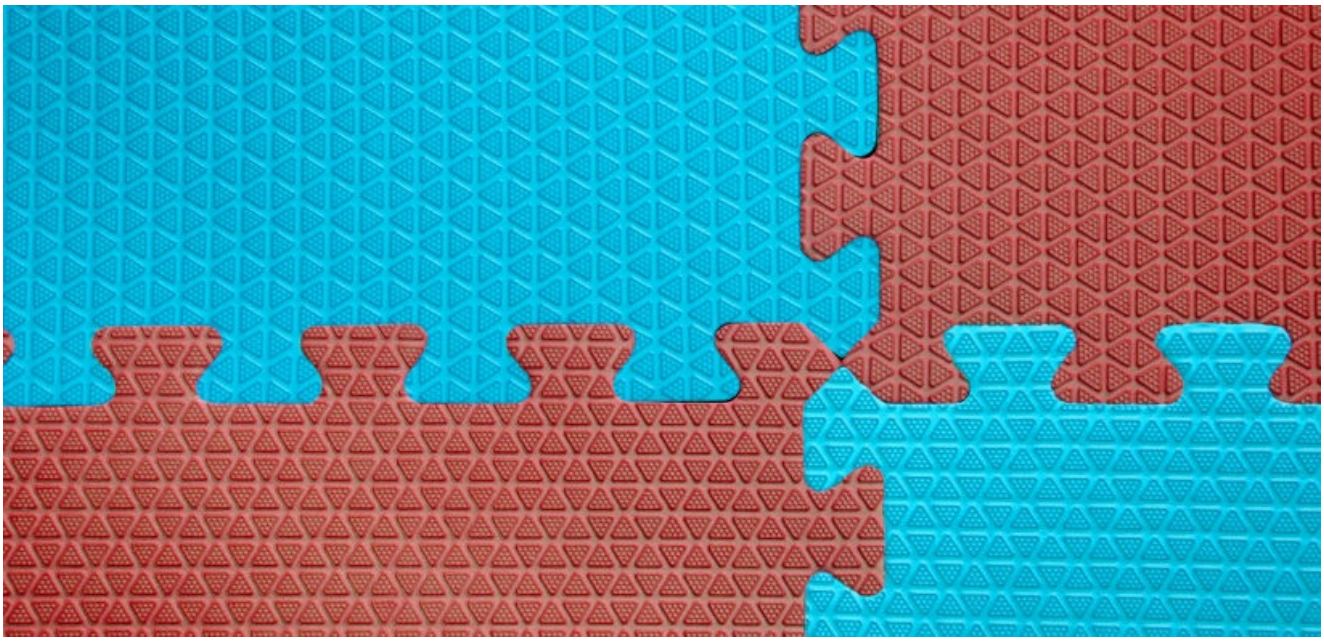

Have you done all you can do to design learning that will truly stick? In this article, we'll share tips for how we implement three primary learning strategies—retrieval practice, spaced practice, and metacognition—in the courses we support in our roles as learning designers in the Colleges of Earth and Mineral Sciences and Business at Penn State University.

Retrieval practice

The more pathways students create in their brains to remember something, the better able they are to recall it from memory. By recalling information, students identify gaps in their learning and also strengthen their memory. Study strategies that students frequently turn to, such as rereading textbooks and looking over notes, unfortunately do not do the trick for long-term memory. Instead, help your students forge pathways to long-term memory by incorporating rigorous recall practice activities within the course content and as part of the course requirements. So, what does retrieval practice look like?

Frequent low-stakes assessments require students to practice recalling information, thereby strengthening learning. These assessments should also provide feedback, either automated or via the instructor, to help students identify any misunderstandings (Karpicke & Blunt,

2011). The feedback could take the form of hints to help students recall and apply content and will help students determine whether more practice or learning is needed. Some examples:

- Create practice quizzes or tests on important concepts that will help students scaffold their learning. Try to ask questions whose answers students cannot look up, such as application or scenario-based questions. Add a reasonable time limit and create a pool of questions to pull from. Consider allowing multiple attempts.
- Have students summarize their notes from memory. Afterward, they can compare with their notes and identify misunderstood or missing concepts.
- Ask students to recall or write out what they remember without consulting their notes (a brain dump). Have students retrieve their knowledge across topics, not just key terms, and expand their explanations during retrieval by asking *why* and *how* questions.
- Combine detailed feedback with retrieval practice. Include explanations about correct answers to help students identify areas that need more work. This can be done by a faculty member or built into the activity.
- Use a variety of question formats on similar topics (open answer, multiple choice, true-false) to help students be more flexible in their retrieval ability.
- Give students hints to help them recall the information. Our brains naturally will build multiple pathways for retrieval, even if we are not aware of it. For example, have you tried to recall a situation, and as soon as someone reminds you of where you heard the material, who you were sitting next to, or the location of the content on the page, you can suddenly remember the details? Hints can help trigger memory for students.
- Create flash card activities for regular practice and suggest that students do not eliminate questions they can answer correctly. Students also need to recall the information before seeing the information. We are tempted to look at the answer before recalling, which can lead to a false sense of understanding.
- Suggest studying in different locations. Our brains register our surroundings when we are learning material, which can help trigger memory.

Spaced practice

Spaced practice is retrieval practice spread out over time. While it's important for students to practice retrieving information they've just learned, it is even better to space this retrieval practice by periodically asking students to recall material and concepts covered previously. Spaced practice leading up to a summative assessment will help deepen learning for students, especially when students "forget" and have to reconnect or make alternative pathways for remembering (Yan, 2016). What does spaced practice look like?

- End every lesson with a few review questions that ask students to recall material from an earlier lecture or lesson. Students will retain knowledge and skills longer when they distribute their practice instead of trying to cram it in all at once (Benjamin & Tulis, 2010).
- Share with students effective recall and spaced practice strategies and the relevance for using them. Have students create and share a plan that incorporates effective learning strategies and outlines what their daily study will include. Brief study sessions are more effective than one long study session before the exam.
- Space learning activities throughout the course. Create short activities that ask students to recall what they viewed or read, identify essential questions from the material, or identify any questions they have about the material.
- Ask students to retrieve material previously covered in the class. Ask students to make comparisons with new content and identify how this new material builds on or differs from what has come before.
- Create different kinds of recall activities and spread them out throughout the content.

Metacognition

Metacognition involves the ability to reflect on one's own understanding. Students with metacognitive skills are better able to recognize when they don't understand something and take appropriate steps to become more proficient (Hacker et al., 2009). Encourage students to reflect on their learning process and how they regulate their learning. Can students identify what learning strategies work well for them? Are they able to identify what to do when they don't understand something? Have they created a reasonable study schedule, and can they adhere to it? Are students able to identify whether they are understanding the material or not? How can we encourage students to develop metacognitive skills?

- Have students create a study schedule and then ask them to reflect on how they are sticking to it and whether modifications are needed. Accountability can help keep a schedule or identify areas to modify.
- Ask students to submit a one-minute paper for which they reflect and independently evaluate what they found to be the most challenging aspect of the lesson.
- Collect exit tickets from students at the end of the lesson or module where they record what they've learned as well as any remaining questions they may have.
- After a lecture or chunk of content, ask students to evaluate their understanding of the material by asking them to submit (via discussion or assignment) the "muddiest points" for them from the content.
- Toward the end of the semester, ask your students to identify what they think will be important to remember one, three, five, and 10 years later.

- Incorporate opportunities to engage students in learning about learning strategies with the emphasis that learning must be effortful to be durable. Start with study strategies that they use and have them tweak them to be more effective. If they make and review information on index cards, ask them to create a retrieval practice activity with the same information.
- Ask students to engage with study strategies in all of their classes. Have them reflect on the strategies that work well. Is it the same for all classes?
- Ask students to explain what they did (or will do) to improve understanding of concepts that were difficult.

Incorporating retrieval practice, spaced practice, and metacognition activities serves the dual purpose of strengthening students' understanding of material while at the same time giving instructors greater insight into how well students are understanding course material. In our next article, we will explore a variety of tools that can be used to support these strategies.

References

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