



Center for Teaching and Learning: Teaching Tip



Taking Advantage of the *Testing Effect* (*Retrieval Practice*)

Note: Commonwealth University's Center for Teaching and Learning, the integrated name for the teaching centers on each campus, will be developing a single website during 2023. In the meantime, the **Teaching Tips** will be located at Bloomsburg's [TALE Website](#) (TALE is the Teaching and Learning Enhancement Center).

Research in cognitive and educational sciences has consistently demonstrated that the study technique of answering test like questions on newly learned material can improve later recall of that material. This phenomenon is known as the *testing effect*, or more recently, as the strategy of *retrieval practice*.

Studies involving retrieval practice have been ongoing since the early nineteen-hundreds, with a recent explosion of research in the past twenty years (Yang et al., 2020). Much of the early research involved laboratory-based settings, however, recent emphasis has been directed towards studying retrieval practice in authentic classroom-based settings. In these studies, the retrieval practice strategy has been compared against a variety of restudy conditions including rereading, review sheets, note-taking, worked-examples, and concept mapping (Agarwal et al., 2021; Yang et al., 2020).

Benefits of Utilizing Retrieval Practice

To date, there is no research-based consensus on the specific underlying cognitive mechanisms that account for the learning benefits seen from retrieval practice. However, there is support for a combination of processes involved and there is consensus that the effects of retrieval practice are strong and can lead to long-term retention, application, and transfer of knowledge (Karpicke, 2017; Rowland, 2014).

The primary explanation of how retrieval practice works is that the process of retrieving knowledge from memory strengthens access to that memory. The key component of retrieval practice may be that this process engages the learner in greater *cognitive effort* compared to other, previously mentioned, study methods. It is proposed that this *retrieval effort*, if both demanding and successful, will increase storage strength in memory. In many studies, greater memory benefits are seen when students answer higher-versus lower-level question types (Karpicke, 2017; Rowland, 2014; Yang et al., 2020).

Studies examining retrieval effects in classroom environments (e.g., Trumbo et al., 2021; Yang et al., 2020) have identified several potential factors that contribute to the success of this strategy.

- **Corrective feedback** should be provided after students answer questions. Feedback has been found to be effective when given either immediately or even in a delayed application. Corrective feedback can help ensure that students are constructing appropriate understandings of newly learned material.
- **Metacognitive processing** can be enhanced in two ways. First, it encourages *monitoring* of cognitive processes as students are engaged in test taking. Second, students can become *aware* of the strengths and gaps within their *knowledge base* as they are retrieving information.

- **Test anxiety** can be reduced with frequent low-stakes testing. Students can become familiar with test-like questions and testing conditions as well as develop the metacognitive understanding of their knowledge base and remediate any gaps in their knowledge that are occurring.
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Applying Retrieval Practice in the Classroom

Retrieval practice can be easily applied in instructional settings and the positive impacts have been demonstrated across many academic domains and classroom modalities.

- **Low-stake quizzing** is the most recommended application of this strategy (Adesope et al., 2017). Low-stake environments can include ungraded practice quizzes, quiz assignments worth minimal points, as well as in-class or clicker-based quiz activities. Low-stake quizzes can be applied frequently, either within or outside of the classroom. Frequent quizzing allows both the learner and instructor to get constant assessments of student learning progress. It also provides students with additional opportunities to receive feedback about their knowledge and performance.
 - **Higher-level questions** have shown more positive effects compared to low-level questions. Results comparing type of test, e.g., free-recall, short answer, multiple-choice, or recognition have demonstrated positive benefits for all methods, however, higher-level, and multiple-choice question types typically have resulted in greater benefits. When students engage in retrieval practice it allows them to assess their own knowledge base, when only low-level or easy questions are provided, it can lead to a knowledge illusion, where students may mistakenly believe they have all the knowledge they need for understanding, when in fact they may not (Trumbo et al., 2021).
 - **Multiple-Choice** items have been found to be highly effective in all learning conditions studied. They are often favored for several reasons including, the amount of content that can be assessed in a single testing session, the levels of complexity that can be assessed (e.g., application, problem solving, synthesis...), as well as their ease (and potential immediacy) of scoring.
 - Multiple-choice questions work best when they promote higher level recall, rather than simple recognition. The key to promoting effective recall is application of **plausible distractors** included along with the correct answer. Plausible distractors require students to select the appropriate answer amongst choices that also appear to be correct (Little et al., 2012).
 - With high-level and well-designed multiple-choice questions, students can assess their own knowledge and avoid the **knowledge illusion** that can occur with other study methods.
 - The benefit for instructors is that they can quickly assess their student's knowledge levels based on overall performance, as well as specific misconceptions they have when students select a particular distractor over a correct alternative.
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Retrieval Practice Variations

Retrieval practice can be combined with other effective study methods to promote improved recall.

- **Distributed practice or spacing**, has been found to be a highly effective study strategy in which learners' study in several short sessions over a period of days, versus a massed-practice approach, with study occurring in a longer session all at once. To accomplish distributed practice in a classroom, smaller quizzes can be assigned with varying due dates throughout a week or unit, encouraging students to distribute their study over time. Instructors can also utilize brief clicker-based questioning as a regular classroom activity.
- **Interleaved study or mixed practice**, where the learner studies multiple topics in a study session, rather than a single topic (blocked practice). This strategy aids recall as the learner is retrieving and activating multiple topics from memory during a study session, rather than just activating one topic at a time.

- Interleaving can be accomplished by mixing questions on various topics within a chapter/unit or by creating quizzes with questions from multiple chapters/units.
- The interleaving effect may also be achieved by utilizing mixed question formats including, free-recall, cued recall, and recognition-based assessment methods. This encourages learners to apply their knowledge utilizing a variety of cognitive processes (Adesope et al., 2017).
- **Student-generated questioning** is a strategy that can be applied as independent assignments where students create their own questions or simply encourage students to use applications such as flash cards or Quizlet. Student self-generated questions can provide retrieval practice benefits but are typically not as effective as instructor-generated assessments (Lloyd et al., 2018).

References

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