



Retrieval Practice & Bloom's Taxonomy: Do Students Need Fact Knowledge Before Higher Order Learning?

Problem 	Is factual knowledge a pre-requisite for higher order thinking? Alternatively, can we foster higher order thinking by engaging directly in complex questioning and materials?
Intervention 	The researcher examined the relationship between factual knowledge and complex higher order learning. Middle school students and College students engaged in retrieval practice with three question types: fact questions, higher order questions, or a mix of both. The researchers wanted to observe which type of questioning would lead to higher order learning.
Comparison 	In lab and classroom settings, retrieval practice consistently improves delayed test performance, compared to re-reading, or no quizzes. Researchers compared three retrieval question types in this study: facts, higher order questions, or a mix of both. Delayed test performance was then observed.
Outcomes 	Higher order and mixed quizzes improved higher order test performance, but fact quizzes did not. Contrary to popular intuition, building a foundation of factual knowledge via retrieval practice did not enhance students' higher order learning.

Three Theoretical Frameworks

The author considered three types of theoretical frameworks to help answer the Problem Question. She sought the similarities and differences between each framework, and considered their implications for the classroom.

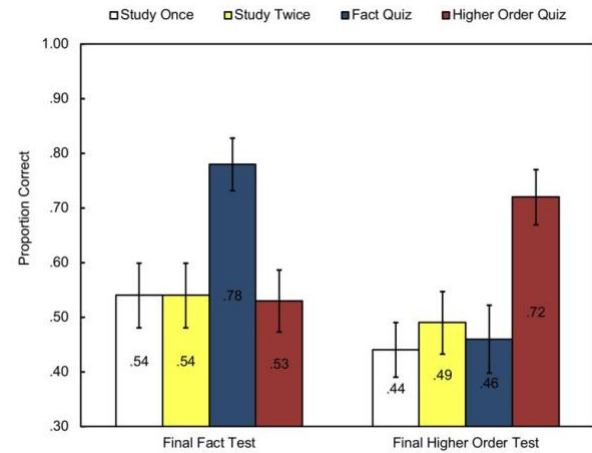
1. **Desirable difficulties:** Challenging and effortful mental processes (for example, short answer quizzes and multiple-choice quizzes) increase retention and application of knowledge, and contribute to greater delayed test performance, when compared with re-studying and no quizzing (p.192)
2. **Transfer Appropriate Processing:** Performance is optimal when encoding process during learning match retrieval process during testing (for example, if students study using multiple-choice questions, they will perform greatest when testing is done with multiple-choice questions) (p.193)
3. **Foundation of Factual Knowledge:** We must teach and re-inforce basic factual knowledge before moving to more complex higher order learning. Willingham (2009) differentiates between rote knowledge and connected knowledge, and suggests that simply learning isolated facts may not contribute to higher order learning (p.193)



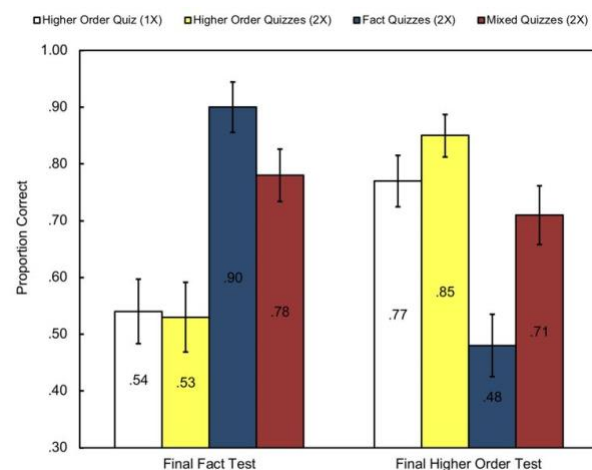
Three Experiments

The author conducted three experiments, where students participated in a study condition (reading a passage), a quiz condition (*note that some students in experiment 1 re-studied material, and some students in experiment 3 did not complete a quiz between study and test conditions*), and a test condition.

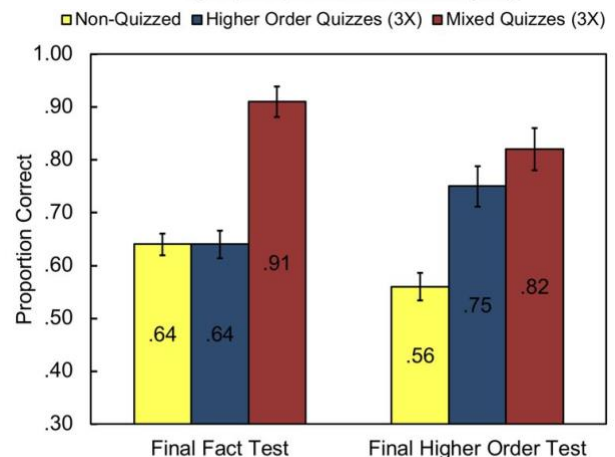
	Experiment 1 (E1)	Experiment 2 (E2)	Experiment 3 (E3)
Who	48 College students (29 female)	48 College students (31 females) –not the same as E1	Applied Setting: 142 6 th grade students (6 classrooms)
How	4 retrieval practice conditions (study once, study twice, fact quiz, higher order quiz) were crossed with 2 delayed (48 hr) test types (fact test or higher order test)	4 retrieval practice conditions (one higher order quiz, two higher order quizzes, two fact quizzes, and two mixed quizzes) were crossed with 2 delayed (48 hr) test types (fact test or higher order test)	3 retrieval practice conditions (higher order quizzes, mixed quizzes, non-quizzed) crossed with two delayed (48 hr) test times (fact test or higher order test)
What	No-quiz and restudy conditions did not improve test performance. Fact quizzes did not enhance delayed higher order test performance. Higher order quizzes did not enhance delayed fact test performance.	Retrieval practice in one quiz format did not benefit performance on a second quiz of different format. Delayed test performance was greatest for the mixed quiz condition.	Mixed retrieval practice produced greatest level of performance on both test types. Delayed performance was greatest for the mixed quiz condition.
Consistent with	Transfer Appropriate Processing Framework Desirable Difficulties Framework	Transfer Appropriate Processing Framework Desirable Difficulties Framework	Transfer Appropriate Processing Framework Desirable Difficulties Framework
Inconsistent with	Foundation of Factual Knowledge Framework	Foundation of Factual Knowledge Framework	Foundation of Factual Knowledge Framework



Agarwal (2019, Experiment 1, *Journal of Educational Psychology*)



Agarwal (2019, Experiment 2, *Journal of Educational Psychology*)



Agarwal (2019, Experiment 3, *Journal of Educational Psychology*)

Agarwal, P. (2019). Retrieval Practice & Bloom's Taxonomy: Do Students Need Fact Knowledge Before Higher Order Learning? *Journal of Educational Psychology*, 111(2), 189-209.



Implications for Teaching (adapted from the author's blog)

We get good at what we practice. Give students the opportunity to practice higher order thinking such as applying, analyzing, or creating.

Transfer is hard. To facilitate transfer, make it an ongoing part of your instructional practice by encouraging higher order thinking, and guiding your students through the process.

Give students a mix of fact-based and higher order retrieval practice. Results from this study indicate that encouraging higher order learning does not have to come after teaching and learning of factual knowledge.

Read more here: <https://www.retrievalpractice.org/strategies/2019/3/27/blooms-taxonomy>

Glossary

Factual knowledge: Knowledge of facts and concepts, sometimes referred to as lower order thinking (remember and understand) in Bloom's revised Taxonomy

Far Transfer: The ability to apply something across context and/or content domains. For example, a medical student learning something from a text book and then applying it in clinical practice with patients (p.191)

Higher Order Thinking: According to Bloom's revised Taxonomy, higher order thinking is to apply, analyze, evaluate, and create. The authors were interested in higher order thinking as **far transfer**, outlined in their taxonomy of transfer, by Barnett and Ceci (2002), occurring across content and/or context domains. (p.191)

Retrieval Practice: The challenge of bringing knowledge to mind strengthens learning, this has been demonstrated in diverse educational settings (from lab to classroom), and across subject areas (p.191)

Further Reading (from the author's reference list)

Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., ... Wittrock, M. C. (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives (abridged ed.). New York, NY: Addison Wesley Longman.

Barnett, S. M., & Ceci, S. J. (2002). When and where do we apply what we learn? A taxonomy for far transfer. *Psychological Bulletin*, 128, 612–637. <http://dx.doi.org/10.1037/0033-2909.128.4.612>

Bjork, E. L., Little, J. L., & Storm, B. C. (2014). Multiple-choice testing as a desirable difficulty in the classroom. *Journal of Applied Research in Memory & Cognition*, 3, 165–170.
<http://dx.doi.org/10.1016/j.jarmac.2014.03.002>

Willingham, D. T. (2009). Why don't students like school: A cognitive scientist answers questions about how the mind works and what it means for the classroom. San Francisco, CA: Jossey-Bass.

More Resources on Retrieval Practice, including Guidebooks, can be found here: <https://www.retrievalpractice.org/>

Agarwal, P. (2019). Retrieval Practice & Bloom's Taxonomy: Do Students Need Fact Knowledge Before Higher Order Learning? *Journal of Educational Psychology*, 111(2), 189-209.