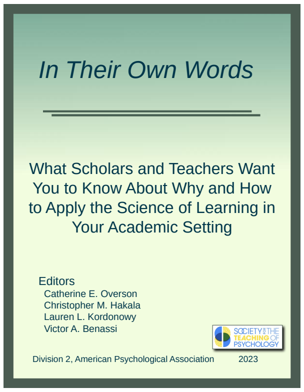

Successive Relearning: An Introduction and Guide for Educators

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Beth and Jeff are both high school basketball coaches and are getting their players ready for the first game of the season. For over a month, they have worked with individual players and their entire teams, drilling them on the basics and practicing key skills during each practice until the players get it right. Their players are ready for the season, yet they still revisit the same drills every practice, so that the players keep working on these skills until they are overlearned. Beth and Jeff also teach biology in their schools. When preparing their students for an exam, they also use a typical approach: they introduce each topic during a lecture and then have students complete a practice worksheet or two over the relevant material, and later they emphasize that those topics will be on the upcoming exam. An evening or two before the exam, students review the material. That is, the teachers present most materials only once and the students essentially cram for the exam. These teachers are not surprised when many of their students perform poorly, because their students often struggle to retain what they have learned well enough to excel on the exams. It may be obvious that these teachers' approach for basketball is different than their approach for biology. But what is the difference, and does it matter?

What is Successive Relearning?

Without even realizing it, Beth and Jeff were using successive relearning to help their players improve their basketball skills. In fact, just about any skill that people are good at has arisen from the application of successive relearning, so let's take a closer look. *Successive relearning* involves combining two other effective strategies – retrieval practice (the "what" to do) and spaced practice (the "when" to do it). Successive relearning involves practice testing in which learners attempt to retrieve sought-after information from memory. Examples of retrieval include trying to recall the meaning of a concept or definition from memory, retrieving the correct name of a structure (e.g., part of a neuron), or even retrieving the stages in a lengthy process (e.g., photosynthesis) by drawing them on a piece of paper. After a retrieval attempt, the answer needs to be scored, and if it is correct, then the student is finished with that particular item for the session. If the answer is incorrect, the student would study the correct response and then complete another practice test on the same item later in that session. The student would continue to test and restudy all items until each had been correctly retrieved. After an initial practice session, the student would return to relearn the same items during two or more subsequent sessions (i.e., spaced practice) to again practice retrieval (with feedback) until all the items are again correctly retrieved.

This sequence of processes is perhaps most easily illustrated by the appropriate use of flashcards (for a detailed flow chart of this sequence, see Figure 1 in Dunlosky & O'Brien, 2020). Each card of a stack would have a test question on one side and an answer on the other. Although students' preferred items for flashcard use are foreign-language translation equivalents (Wissman et al., 2012), the question and answer on each card could also involve other kinds of content (e.g., lengthy, conceptual, and complex material). As a student takes each test and scores the answer, the current card would either be set aside (if the answer was correct) or put at the end of the stack to practice again (if the answer was incorrect). In this way, the practice test for items would be spaced (with the interval between practice attempts being filled with the practice of other items) within each session. As we discuss under Frequently Asked Questions, flashcards can be real or virtual; that is, actual cards do not need to be used, and just about any course material (e.g., notes or even textbook content) can be easily altered to function as flashcards. For instance, in a textbook, students could place sticky notes over the definitions of key terms, leaving the key term itself uncovered. They could take a test by trying to write down the meaning of each concept from memory and then revealing the answers for further study. The students would work from beginning to the end of a chapter, returning to the beginning until all concepts had been correctly retrieved.

Although successive relearning involves both retrieval practice and spaced practice, it is critically different than just combining the two techniques as they are typically used. First, retrieval practice often involves a single attempt at retrieving a concept (e.g., attempting to answer a single multiple-choice question for a given item), whether the concept is correctly retrieved or not. This retrieval attempt can have a positive impact on students' learning (for reviews, see McDaniel & Little, 2019; Rowland, 2014), especially when the answers are correctly retrieved (cf. Kornell et al., 2009; Little et al., 2012). By contrast, for successive relearning, students (a) continue to practice retrieval (with feedback) until they correctly recall all the information at least one time during a single session and, as important, (b) return to the same content to relearn it during one or more sessions. As noted above, practice within a session for a given item would be spaced, because if an answer is incorrect for an item, then that item would not be tested again until other items within the to-be-learned set (e.g., a flashcard stack) are practiced. Given that successive relearning (obviously) involves relearning, the practice of all items is also spaced across days, which would further boost its impact on long-term retention.

How might successive relearning improve student achievement? The answer is simple – after correctly recalling even simple information a single time (e.g., the answers to questions like "What is the word for *retrieval* in Spanish?" Answer: *recuperación*), people will eventually forget it and need to practice it again (perhaps across multiple sessions) to retain it over the long term (for further discussion, see Bahrick, 1979; Dunlosky & O'Brien, 2020). Thus, by successfully practicing the same content across multiple sessions, retention of that material increases after each one, resulting in enhanced achievement. In fact, successive relearning is foundational to most expertise. Consider work by Harry Bahrick and colleagues (Bahrick, 1979; Bahrick & Hall, 1991; Bahrick et al., 1994) who explored why some people retain competency over a lifetime, whether it be their ability to solve algebra problems or speak fluently in a language when moving to a foreign country. They discovered that (very) long-term retention involved using that knowledge across a lifetime.

The Promise of Successive ReLearning: Experimental Demonstrations With Course-Relevant Content

To date, only a few experiments on successive relearning have explored how it impacts knowledge of content from courses in which students are enrolled (Higham et al., 2022; Janes et al., 2020; Rawson et al., 2013). We briefly review these studies. Rawson et al. (2013) and Janes et al. (2020) used similar methods aimed at improving college students' achievement in an Introductory Psychology course and in a Biopsychology course, respectively. Examples of the content are presented in Table 1.

Table 1

Example Materials From Classroom-based Research on Successive Relearning

Article	Question/Prompt	Answer
Rawson et al. (2013)	What is the availability heuristic?	The tendency to estimate the likelihood that an event will occur by how easily instances of it come to mind.
	What is the mere exposure effect?	The phenomenon whereby the more people exposed to a stimulus, the more positively they evaluate that stimulus.
	What is hindsight bias?	The tendency, once an event has occurred, to overestimate one's ability to have foreseen the outcome.
Janes et al. (2020)	Image: Arrow pointing to	Name/label of region
	What are meninges?	Protective membranes surrounding the brain and spinal cord.

Note. For images, students were shown an image with an arrow pointing to a region of it; depending on the image, students would practice retrieving the name of the region (e.g., frontal lobe) or the process depicted in the image (e.g., if an arrow pointed to the state of a cell immediately before an action potential, the answer would be "cell at rest").

In both studies, each student was assigned to use successive relearning to learn concepts on virtual flashcard stacks; each stack typically included 6-8 concepts, and concepts in a given stack were taken from the same unit (e.g., one stack for Introductory Psychology included concepts relevant to judgment and decision making). Students used successive relearning to learn these concepts on three or more sessions that were separated by at least one day. Moreover, students began using successive relearning to learn a set of concepts when the instructor introduced them in class. Note that during retrieval practice of concepts, the students were told that they did not have to produce a verbatim copy of the answer, but instead they were encouraged to recall the meaning of concepts in their own words. The students scored the correctness of an answer, and if correct, the item was dropped from that session; if the answer was incorrect, the students continued to practice it more. Finally, each student was assigned other *business-as-usual* concepts, which the students could learn in any manner that they wanted (whether concepts were assigned to the successive-relearning condition or the business-as-usual condition was counterbalanced across students). The rationale for using these business-as-usual concepts as a baseline condition is straightforward: If successive relearning does not help students improve their achievement as compared to how they already prepare, then it would not seem prudent to encourage its use.

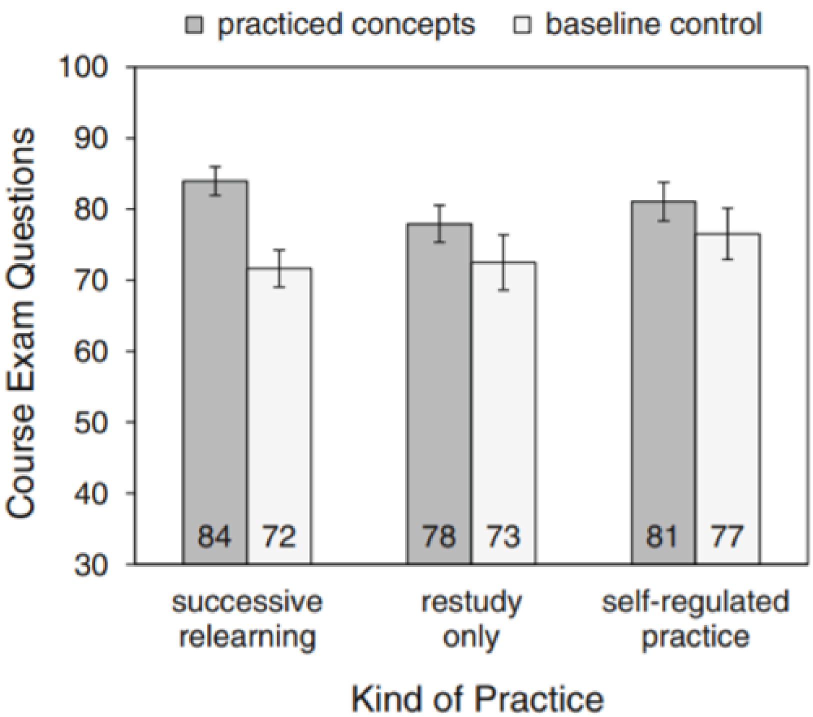

Figure 1. From "The power of successive relearning: Improving performance on course exams and long-term retention," by K. A. Rawson, J. Dunlosky, & S. M. Sciartelli, 2013, *Educational Psychology Review, 25,* 523-548. Copyright 2013 by Springer. Reprinted with permission.

Figure 1 presents outcomes from Rawson et al. (2013, Experiment 1), with the left-most bars highlighting the critical outcome: Successive relearning boosted exam performance over 10% as compared to the baseline control. Similarly, students who used successive relearning to study biopsychology content also obtained about a 10% boost in their exam performance (Janes et al., 2020). Rawson et al. (2013, Experiment 1) included two other groups. One group had the same practice schedule as students using successive relearning, but students in this group used the practice time to restudy the content instead of engaging in retrieval practice. This restudy-only group (Figure 1, middle bars) also benefited from spaced restudy (as compared to the baseline control condition in which participants did not practice concepts but were later tested on them), but not as much as compared to those who used successive relearning. Thus, practicing retrieval is an active ingredient for how successive relearning boosts achievement. Another group was given the same schedule as those using successive relearning, but students in this self-regulated practice group could practice the content in any way they wanted (i.e., they could test themselves, restudy, or do nothing). As shown in the right-most bars of Figure 1, these students also benefited from spaced practice, but not as much as the successive-relearning group (for detailed analyses of how these students regulated their learning, see Janes et al., 2018). Two other aspects of Rawson et al. (2013) are also notable. First, although students successively relearned by attempting to retrieve the meaning of the definitions from memory, none of the questions on the in-class exam involved identifying definitions; instead, students had to use their understanding of a definition to correctly answer questions, so successive relearning facilitated the application of those concepts on (near) transfer questions. Second, another experimenter-developed test that did involve recalling the meaning of definitions was administered 24 days after the exam. Students recalled over 60% of the concepts correctly when they used successive relearning to study them, whereas they recalled less than 20% when they learned the concepts on their own. This outcome highlights the power of successive relearning to support long-term retention, as well as demonstrating that students' reliance on cramming to study course materials results in rapid forgetting.

Higham et al. (2022) also explored the possible benefits of successive relearning while matching time on task between successively relearned material and material that was learned by restudy alone (i.e., a well-controlled version of the restudy-only group in Rawson et al., 2013). After each lecture of a large undergraduate psychology course, students studied concepts from the prior class (e.g., Attitudes are composed of affective, cognitive, and behavioral components) on three separate days either using successive relearning or restudy. When using successive relearning, students attempted to recall a missing term (e.g., Attitudes are composed of ____?____, cognitive, and behavioral components), and then the correct answer was presented. For the restudy condition, the concept was presented in its entirety. Across the lectures, students alternated between using successive relearning or restudying alone to practice particular concepts, so all students used each technique for about half the concepts. And, for the successive relearning and restudy conditions, the overall time on task was approximately equated. The criterion tests were administered about 42 and 68 days after the final practice session (no questions were repeated across these tests). The criterion tests included the following: *repeated questions* that involved recalling the terms that were practiced during successive relearning (e.g., Attitudes are composed of _____?_______, cognitive, and behavioral components); *transfer questions* that involved recalling a different term (e.g., Attitudes are composed of affective, ______?______, and behavioral components) or new questions that had not been practiced.

For the repeated questions, students recalled significantly more of the practiced terms 42 days after practice when they had used successive relearning than when they restudied alone, and the benefit of using successive relearning (albeit smaller) was also significant 68 days after practice. The benefit was minimal for transfer and new questions. The authors also reported outcomes from a host of other measures (see Higham et al., 2022, for details) that further demonstrated the broader impact of successive relearning. For instance, early in the course, students judged that restudy was more effective than successive relearning, but after they had used both, they judged successive relearning as more effective. Students also initially indicated they were more anxious using successive relearning than restudy, whereas after using both, they reported less anxiety when using successive relearning. These and other outcomes led the authors to conclude that "[o]ur research indicates that successive relearning is a valuable addition to any university course and is easy to implement" (Higham et al., 2022).

The final study on successive relearning that we review here (Rawson et al., 2020) was not connected to a specific course but did involve learning foundational concepts in probability. College students attempted to learn how to solve four different kinds of probability problems. They attempted to solve a novel problem of each kind and received feedback (whether their answer was correct and the correct solution) after each attempt. (So that students would need to solve a novel problem for each attempt, we developed 17 isomorphic problems for each kind of probability problem.) They continued to cycle through answering problems (with feedback) until they had correctly answered one problem of each kind. For the successive relearning group, students then repeated the same learning session on three separate days – so they continued to practice until they could correctly solve each kind of problem during three separate sessions. Students in the comparison group completed just one session in which practice continued until they correctly solved three problems of each kind. One week after the final practice session, students completed a criterion test that involved solving novel problems. Across multiple experiments, the successive relearning group demonstrated a significant advantage on the criterion test, but the effect size was small (Cohen's d = .28); average performance was also around 50% or less for the successive relearning group, which means even more (or a different kind of) practice may be needed to gain mastery. Thus, although successive relearning did help students learn to solve probability problems, further research will be required to discover how best to use successive relearning in service of improving students' problem solving.

Barriers to Using Successive Relearning Effectively and Recommendations to Overcome Them

What should be evident from the examples discussed above is that successive relearning can have a positive impact when students are learning complex and conceptual materials; that is, successive relearning can be beneficial for more than just learning foreign-language vocabulary. Even so, we suspect that a variety of barriers will need to be overcome for teachers and students to fully capitalize on its power. We consider some of these barriers here, along with possible approaches to overcoming them.

Barrier #1

***Students do use successive relearning, but they report using it largely to learn foreign-language vocabulary*.** Certainly, successive relearning is an excellent strategy to learn foreign-language translation equivalents. However, many students do not realize that they can use (or simply do not try using) successive relearning to learn conceptual definitions, scientific processes, lengthy text materials, et cetera. Currently, we are unsure how to motivate students to use successive relearning for learning content other than foreign-language translations, although instructing students about the benefits of successive relearning and allowing them to experience those benefits while learning more complex material may increase the likelihood that they take advantage (cf. McDaniel & Einstein, this volume).

Barrier #2

***Using successive relearning can be time consuming*.** One reason why some students may not use successive relearning for more complex materials is that it takes time to develop the materials, such as by writing key terms on one side of each flashcard in a set and their lengthy definitions on the other side. Moreover, for studying lengthy definitions, students will need to schedule enough time to learn them well enough to recall their meanings. Concerning the barrier to build the material sets, many virtual flashcard programs are available (and free), and most allow students to share flashcard stacks (for details, see Dunlosky & O’Brien, 2020) – so students can share the burden of developing materials. Concerning the time needed to learn and relearn the materials, we offer three pieces of advice. First, let your students know that using successive relearning will require time, but if they stick with it, they will experience the benefits. Second, let them know that relearning is much faster than is initial learning. It may take students 30 to 40 minutes to initially learn to correctly recall eight to ten lengthy definitions, but during the first relearning session, they may need only about 15 minutes, and the next session will likely take fewer than 5 minutes (e.g., Rawson & Dunlosky, 2011). The success experience itself will contrast a common student experience of studying a lot and gaining little and may encourage some students to use successive relearning more regularly. Plus, as students use successive relearning, they will also experience the dramatic speed-up from initial learning to relearning. Finally, we recommend that every instructor considers “what is worth learning” – what do students need to remember and use well after your course is done? Consider identifying the smallest number of “must know” concepts from a course and give your students extra kudos for mastering those by using successive relearning.

Barrier #3

***Even if students plan to use successive relearning and develop the materials to do so, they will need to manage their time to use it with fidelity*.** One possibility is to have students use a calendar to note when a particular material set should be started (e.g., when the concepts are introduced in a lecture) and revisited for relearning sessions (e.g., for three extra sessions separated by 2 days). It would be even better if their calendar sent reminders about when they should be learning (or relearning) different material sets. Of course, having multiple study sessions for a given course each week stands in stark contrast to students’ propensity to wait to cram an evening or two before an exam (Blasiman et al., 2016; Taraban et al., 1999), so reminders to study (and use successive relearning) regularly may be valuable. Fortunately, some of the flashcard programs available on the internet have built-in calendars and messaging systems, so that students can set up a study schedule that will allow them to use successive relearning with fidelity (Dunlosky & O’Brien, 2020).

Barrier #4

***Many people believe that successive relearning is just for memorization and cannot help students develop a deeper understanding of conceptual material*.** This barrier pertains to any instructor or student who does not understand that memory is foundational for human performance of any kind. For instance, to answer conceptual questions about the outcome of a memory experiment about whether recency and primacy effects will occur when students attempt to recall a list of words from memory, a student can apply Atkinson and Shiffrin's (1968) model of memory that includes short-term and long-term memory. Using this model to develop predictions involves coordinating several concepts, such as the meanings of recency and primacy effects, the size of short-term memory, the control processes involved in short-term memory, transfer to long-term memory, et cetera. Doing so would likely be difficult if all those concepts were not readily accessible from memory – so, in this case, using successive relearning to enhance memory for the individual concepts promises to impact students' ability to apply the model to make predictions. Also, the first author has heard instructors lament that students memorize all the material but it does not help them; the mistake here is believing that the students are actually memorizing the content well enough to remember it. Instead, many students do not use effective techniques to learn course content, so they may believe that they are doing a good job "memorizing" the content, when in fact their retention of the content is fragile and will not support its use in answering application questions.

Moreover, your own experiences may highlight that even a solid conceptual understanding of a process can be forgotten without practice. For instance, after teaching signal detection theory, the first author developed a relatively solid understanding of the basics, but not so long after teaching it, he quickly forgot his *understanding* of this theory. He needed to use successive relearning to revisit his understanding of signal-detection theory to achieve long-term retention, just like using algebra throughout one's life ensures that an understanding of the basics will not be forgotten (as per H. Bahrick's research, e.g., Bahrick et al., 1994). Put differently, even comprehension of an idea can be forgotten, and when it is, it would need to be relearned.

Some Frequently Asked Questions

In discussing effective learning techniques with instructors and students, we hear many of the same questions, and here are some of them along with our (currently) favored answers.

***Is successive relearning just flashcards*?** No. Flashcards can be used to instantiate successive relearning, but flashcards can be used in a variety of different ways that will not necessarily produce durable learning. Moreover, successive relearning can be instantiated using other materials as well, such as textbooks and notes (for examples, see Dunlosky & O'Brien, 2020). For notes, one recommendation is to have students write on only one side of each sheet of paper, and then they can use the reverse, blank side to write down content that they are attempting to retrieve from memory.

Can students accurately score the quality of their responses when practicing retrieval? Having students score their own responses is essential for using successive relearning in some contexts, such as when students learn lengthy conceptual definitions or scientific processes. Accurately scoring the responses is essential, because if a student is overconfident and scores incorrect responses as correct, then the student may drop items from practice too early, which would result in poor retention (Dunlosky & Rawson, 2012). Of course, students can compare their responses with the correct answers, but they may still have difficulties scoring long responses accurately without some form of scaffold or instruction. An important avenue for future research will be discovering techniques for ensuring that students can accurately score responses of any kind.

***Do students need to write down what they are trying to recall, or can they just recall the content covertly*?** Students do not need to overtly produce (e.g., write, type, or say aloud) the information they are trying to recall from memory, but doing so may provide advantages. First, when attempting to covertly recall lengthy responses, students may not do a full-blown retrieval attempt. By contrast, writing down responses may increase the chances that they retrieve all they can from memory, which in turn will enhance their retention of the material (for relevant evidence, see Tauber et al., 2018). As important, when students write down their best response, they may have an easier time scoring it accurately, because they would not need to rely on a limited working memory to hold their (potentially lengthy) response in mind while comparing it to the correct answer.

Will successive relearning benefit younger students? The scant experimental research on successive relearning has almost exclusively involved adults. Even so, children and younger students show the benefits of retrieval practice and spaced practice, so it follows that they would also benefit from using successive relearning. We know of only one experiment evaluating the benefits of successive relearning for children (Rawson et al., 2021). The experiment was designed to evaluate whether relearning sessions boosted eighth graders' retention of concepts from a unit on statistics. The concepts were key term and definition pairs, such as "What is the mode? The number or object that appears most frequently in a set of numbers or objects." One hundred seventy-four students from eight different classes initially learned to recall the meaning of each definition from memory. For retrieval trials, students were prompted with a key-term question (e.g., "What is . . . ?") and were asked to type the meaning of the concept in their own words. After this initial learning session, the students were randomly assigned to complete zero, one, two or three relearning sessions. As during initial learning, each relearning session involved practice test–restudy trials until each definition was correctly recalled once. One month after the final practice session (either after the initial learning session for the zero relearning group or after the last relearning session in each of the other groups), students completed a final cued recall test over the practiced concepts (as well as for baseline control concepts that were included in the unit but were not presented during any learning sessions; baseline and practice concepts were counter-balanced across students).

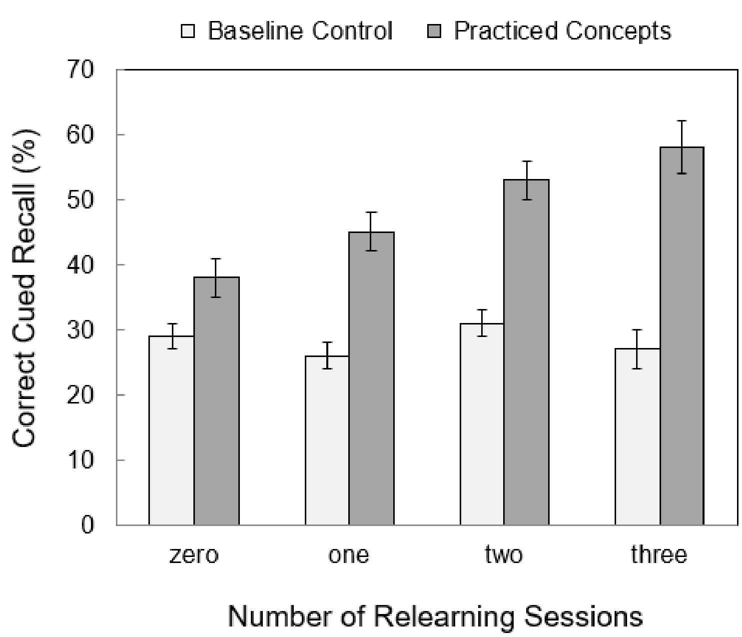

Figure 2. Mean correct cued recall of definitions as a function of the number of relearning sessions completed prior to the final test one month later (baseline control concepts were not practiced in any session of the experiment). Error bars report standard error of the mean.

As shown in Figure 2, performance on the final test was greater for concepts that the students practiced than for the baseline concepts. Most important, the relearning sessions significantly boosted performance. A month after practice, students who completed three relearning sessions recalled nearly 60% of the concepts from memory. But how much extra time did relearning require? Students used about 3 minutes to reach a criterion of one correct recall during the initial learning session, but they sped up across relearning sessions. By the third relearning session, students used only about a minute on average to relearn each concept.

How many items should be studied within a given session? Or, in terms of using flashcards, how many cards should be in a given stack? We suspect the answer to this question will depend on many factors, such as how much time a student is willing to use for each study session, the length and complexity of materials, and so forth. For instance, if students are using successive relearning to learn foreign-language translation equivalents, we suspect that a given stack could be rather lengthy. By contrast, initially learning to recall the meaning of conceptual definitions can be time consuming, so students may want to include relatively few (8 – 10) in a given stack.

How many relearning sessions should students use for a given set of material? When preparing for exams in a course, the number of days between exams (and amount of material) will likely limit how many sessions that students could schedule. For instance, if each exam is separated by four weeks and covers a great deal of material, that probably leaves just enough time to relearn materials on two (perhaps three) extra sessions. If the exams are followed by a cumulative final exam, then students could return to the material previously introduced to engage in one or two relearning sessions near the end of the semester. If the students previously used successive relearning to learn the material, they will retain much of the material across the course (Rawson et al., 2013), and for material they have forgotten, relearning will be rapid. Thus, relearning for these final booster sessions should not take a great deal of time. If students care to retain that material beyond the course (e.g., for an entrance exam to medical school), then they will likely need to revisit the material to relearn it. Again, we suspect that such relearning would be relatively quick and that many students will be amazed by how much they retained. With this optimism in mind, however, we must emphasize that research has not yet systematically explored “how much is enough” for producing (extremely) long-term retention of knowledge. Given the promise of successive relearning, a major challenge for educational research will be to better understand how much successive relearning is required to enjoy its long-term benefits.

Closing Remarks

Beth and Jeff use successive relearning to coach their basketball teams, which is consistent with this modified version of an old adage: “try until you succeed, and then try, try again (until you succeed a few more times).” Just imagine if Beth and Jeff also supported the use of successive relearning in their biology course. They could develop material sets for their students to learn successively after school, perhaps even having their students begin learning (and relearning) content while the material is being first introduced in class lectures. Outside of class, the students could master definitions, the sequences of biological processes, the names of biological structures, and much more; and then Beth and Jeff could spend class time helping students more deeply understand and use the content. Of course, we do not know how the students would fare in such a situation, but given the current evidence on successive relearning, it seems likely that most students would obtain a boost in their grades and long-term retention of biology. And, after all, if students already use successive relearning to excel at their extracurricular activities – such as video games, sports, and music – why shouldn’t instructors help students use successive relearning with fidelity in their academic learning? We hope that this brief guide about successive relearning will entice you to try it out yourself, either with your students or while you are trying to master new content for your discipline or pastime.

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References

Atkinson, R.C. & Shiffrin, R.M. (1968). Human memory: a proposed system and its control processes. In K.W. Spence & J.T. Spence (Eds.), *The psychology of learning and motivation: Advances in research and theory. (Vol. 2)* (pp. 89–195). Academic Press.

Bahrick, H. P. (1979). Maintenance of knowledge: Questions about memory we forgot to ask. *Journal of Experimental Psychology: General*, *108*(3), 296–308. https://doi.org/10.1037/0096-3445.108.3.296

Bahrick, H. P. and Hall, L. K. (1991). Lifetime maintenance of high school mathematics content. *Journal of Experiment Psychology: General*, *120*(1), 20–33. https://doi.org/10.1037/0096-3445.120.1.20

Bahrick, H.P., Hall, L.K., Goggin, J.P., Bahrick L.E. & Berger, S.A. (1994). Fifty years of language maintenance and language dominance in bilingual Hispanic immigrants. *Journal of Experimental Psychology: General*, *123*(3), 264-283. https://doi.org/10.1037/0096-3445.123.3.264

Blasiman, R. N., Dunlosky, J., & Rawson, K. A. (2017). The what, how much, and when of study strategies: Comparing intended versus actual study behaviour. *Memory*, *25*(6), 784–792. https://doi.org/10.1080/09658211.2016.1221974

Dunlosky, J., & O'Brien, A. (2020). The power of successive relearning and how to implement it with fidelity using pencil and paper and web-based programs. *Scholarship of Teaching and Learning in Psychology*. https://doi.org/10.1037/stl0000233

Dunlosky, J. & Rawson, K. A. (2012). Overconfidence produces underachievement: Inaccurate self evaluations undermine students' learning and retention. *Learning and Instruction*, *22*(4), 271-280. https://doi.org/10.1016/j.learninstruc.2011.08.003

Higham, P. A., Zengel, B., Bartlett, L., & Hadwin, J. A. (2022). The benefits of successive relearning on multiple learning outcomes. *Journal of Educational Psychology*, *114*(5), 928–944. https://doi.org/10.1037/edu0000693

Janes, J., Dunlosky, J., Rawson, K. A., & Jasnow, A. (2020). Successive relearning improves performance on a high-stakes exam in a difficult biopsychology course. *Applied Cognitive Psychology*, *34*(5), 1118-1132. https://doi.org/10.1002/acp.3699

Janes, J., Dunlosky, J., & Rawson, K. A. (2018). How do students use self-testing across multiple study sessions when preparing for a high-stakes exam? *Journal of Applied Research in Memory and Cognition*, 7*(2)*, 230-240. https://doi.org/10.1016/j.jarmac.2017.11.003

Kornell, N., Hays, M.J., & Bjork, R. (2009). Unsuccessful retrieval attempts enhance subsequent learning. *Journal of experimental psychology. Learning, memory, and cognition, 35(4),* 989-98. https://doi.org/10.1037/a0015729

Little, J. L., Bjork, E. L., Bjork, R. A., & Angello, G. (2012). Multiple-choice tests exonerated, at least of some charges: Fostering test-induced learning and avoiding test-induced forgetting. *Psychological Science*, *23*(11), 1337-1344. https://doi.org/10.1177/0956797612443370

McDaniel, M. A., & Little, J. L. (2019). Multiple-choice and short-answer quizzing on equal footing in the classroom: Potential indirect effects of testing. In J. Dunlosky & K. A. Rawson (Eds.) *The Cambridge handbook of cognition and education* (pp. 480-499). Cambridge University Press.

Rawson, K. A., & Dunlosky, J. (2011). Optimizing schedules of retrieval practice for durable and efficient learning: How much is enough? *Journal of Experimental Psychology: General, 140(3),* 283-302. https://doi.org/10.1037/a0023956

Rawson, K. A., Dunlosky, J., & Janes, J. L. (2020). All good things must come to an end: A potential boundary condition on the potency of successive relearning. *Educational Psychology Review*, *32*(3), 851-871. https://doi.org/10.1007/s10648-020-09528-y

Rawson, K. A., Dunlosky, J., & Sciartelli, S. M. (2013). The power of successive relearning: Improving performance on course exams and long-term retention. *Educational Psychology Review, 25*(4), 523-548. https://doi.org/10.1007/s10648-013-9240-4

Rawson, K. A., Wissman, K. T., & Dunlosky, J. (2021). *Grade-school students' memory for statistical concepts benefits from successive relearning*. Unpublished data.

Rowland C. A. (2014). The effect of testing versus restudy on retention: a meta-analytic review of the testing effect. *Psychological Bulletin*, *140*(6), 1432–1463. https://doi.org/10.1037/a0037559

Taraban, R., Maki, W.S. & Rynearson, K. (1999). Measuring study time distributions: Implications for designing computer-based courses. *Behavior Research Methods, Instruments, & Computers 31*(2), 63–269. https://doi.org/10.3758/BF03207718

Tauber, S. K., Witherby, A. E., Dunlosky, J., Rawson, K. A., Putnam, A. L., & Roediger, H. L. (2018). Does covert retrieval benefit learning of key-term definitions? *Journal of the Association of Research, Memory, and Cognition*, *7*(1), 106-115. https://doi.org/10.1016/j.jarmac.2016.10.004

Wissman, K. T., Rawson, K. A., & Pyc, M. A. (2012). How and when do students use flashcards? *Memory, 20(6),* 568-579. https://doi.org/10.1080/09658211.2012.687052