

Spaced, interleaved and retrieval practice: The principles underlying the Daily Review

In this article, classroom teacher **David Morkunas** explains three principles of learning: spaced practice, interleaved practice, and retrieval practice. These all come together in a powerful classroom routine: the Daily Review. Extra suggestions are provided for supporting students with learning difficulties.

I teach Grade 4. For 40 weeks a year, I have the pleasure of stuffing my students' brains with as many skills and pieces of knowledge as possible before shipping them off to the verdant fields of Grade 5. There are no end-of-year exams in my year level, so my main concern as we approach summer is ensuring that my students remember what we have taught them, so that they can build on these ideas when they hit the older grades. Like many teachers, I fear that the summer holidays, while necessary (and well-earned!), represent the perfect opportunity for students to forget everything they have learned throughout the year.

So how do we know that a student has learned something? Can we really

say that a student has nailed something if they cannot remember it six weeks after it was taught? We know that learning represents a change in long-term memory, so teaching a concept once during a school year and then leaving it for the next teacher to cover will not lead to effective retention of ideas.

This is where the ideas of spaced, interleaved, and retrieval practice come in. These techniques are designed to strengthen the connections in students' memories, allowing them to remember what they have been taught for longer. The good news is that they are easy to understand, and do not require huge amounts of work to implement in the classroom.

Spaced Practice

As the name suggests, *spaced practice* involves scheduling your study sessions at regular intervals. This is contrasted by *cramming*, which is the art of studying immediately before a test or exam.

The research suggests that cramming is effective if you are simply aiming to do well on an assessment. Sadly, the effects are short-lived, and the material is soon forgotten once the test is over (I am living proof of this: I can barely remember a thing from the commerce degree I studied before teaching).

Spaced practice is beneficial in that it helps to counteract Ebbinghaus' forgetting curve, wherein we begin to forget knowledge and skills immediately upon learning them (Weinstein & Sumeracki, 2019, p. 88). By providing students with regular opportunities to review prior learning, they are far more likely to transfer knowledge and skills into long-term memory. At my school, we review prior learning every day (more on this later).

Interleaved Practice

Interleaved practice is the idea of studying a range of topics during a single study session, as opposed to

focussing on a single domain (usually called *blocked practice*). Imagine that you are studying for a maths test, and you have three topics to revise (A, B, and C). This is what a *blocked practice* approach might look like:

- Monday: Topic A (60 mins)
- Wednesday: Topic B (60 mins)
- Friday: Topic C (60 mins)

This is very similar to how I studied during my school days. Now consider a schedule which uses *interleaved practice*:

- Monday: Topic A (20 mins), Topic B (20 mins), Topic C (20 mins)
- Wednesday: Topic B (20 mins), Topic C (20 mins), Topic A (20 mins)
- Friday: Topic C (20 mins), Topic A (20 mins), Topic B (20 mins)

Notice that we are still studying each topic for the same length of time. The difference is that we are studying each topic in shorter blocks and weaving them together during each study session. Interleaving is still a relatively new idea in research, but its efficacy has been measured across many different domains, including mathematics, music, and sport (Weinstein & Sumeracki, 2019, p. 93).



Retrieval Practice

Retrieval practice is the act of bringing information from long-term memory into working memory. As humans, we do this every day: remembering someone's address, or a sourdough recipe, or an actor's name are all examples of retrieval practice. Retrieving information from long-term memory allows us to strengthen this information, making it more durable and less likely to be forgotten (Kirschner & Hendrick, 2020, p.213).

In the classroom, we can provide our students with opportunities to recall concepts that we have taught previously by using frequent low-stakes quizzes that we call Daily Reviews (discussed in more detail below). This has the added benefit of telling us as teachers who has remembered skills and knowledge and who might need to be retaught.

Bringing it all together – The Daily Review

Now that you are familiar with these three ideas, it is time to look at how they can be used in practice. Please note that the approach I outline below is what we have chosen to use at Bentleigh West Primary School: it is by no means the approach that you *must* use at your school. There are myriad examples of daily and monthly reviews online and in books; feel free to borrow and steal the ideas that you feel would work for you.

The *Daily Review* is a 20-25 minute session that runs at the beginning of every Maths and English block. It uses the ideas of spaced, interleaved, and retrieval practice to revise previously taught knowledge and skills in order to ensure that our students consolidate their understanding and cement the changes to their long-term memory. If you wish to follow me down this exciting path and begin doing these sessions in your classroom (I promise, it really is fun for all concerned), then you will need a few things:

Mini Whiteboards

An absolutely essential piece of kit. These allow you to scan student answers at a moment's notice and determine almost instantly whether your class understands what you have just taught. If my room were ablaze and I could only retrieve one thing, it would be the mini whiteboards. Take them from my cold, dead hands.

Review Material

You need some way to present the previous learning to your students in a

quick and dynamic fashion. We create most of our lessons in PowerPoint, so it is simple to grab those slides, pare them down to the essentials, and use them for our Daily Reviews. It takes a bit of work to get started, but after a while you too will become a sorcerer of slides. That being said, you certainly don't have to use PowerPoint – I have seen people conduct review sessions using paper quizzes, cloze activities, and active recall sessions where students are required to write down what they can remember about topics. We find that PowerPoint works well for our purposes, but your mileage may vary.

When it comes to the material itself, brevity is your friend. If you are converting lesson materials into review materials, you must cut down anything unnecessary or superfluous and focus on the core principals in each topic. Each section should include a student-friendly definition, maybe a rule for the class to recite, an example question to run through quickly and then some work for students to complete independently. Note that you won't need to do each part of a topic every time you review it (more on this below).

Schedule of Topics

It is important to keep track of when you first teach a concept, so that you know when to include it in a Daily Review and when to leave it out. I receive a lot of queries about how long the gaps should be, but the research doesn't yet point to a clear answer (Weinstein & Sumeracki, 2019, p.142). If you leave topics in your reviews for too long, students will not be able to take advantage of retrieval practice. Conversely, if you leave topics out for an extended period, you run the risk of students simply forgetting the material. We generally review concepts for the next few days after they are taught, then bring them back after a couple of weeks for a day or two. Depending on how well the students do, we then decide whether to leave a topic in, remove it for the same length of time, or remove it for a longer period.

Timetabling

You need to carve out time in order to administer your Daily Reviews. We run our English and Maths Reviews at the beginning of their respective blocks, after which we move on to other activities. Think closely about the makeup of your timetable and try your best to make the time for the reviews.

Now that you have your ducks in a row, how does a Daily Review work?

1. Decide on which topics to review

This will be a combination of topics you have taught recently, as well as a selection of topics that you have taught previously throughout the year. At the beginning of the school year, it is really helpful to review content from the previous school year (I coordinate closely with the Year 3 teachers to decide on what to include in these first few weeks). For a Maths Review, I will choose anywhere from 8-12 topics, and spend no more than a couple of minutes on each. This ensures that students benefit from *interleaved practice*. Here is a sample of the topics that we might cover in a Maths or English Review:

Maths Review (Grade 4)

- x4 multiplication facts
- Subtraction across multiple zeroes
- Short division
- Decimal place value
- Prime factorisation
- 12-to-24 hour time conversions
- Classifying angles
- Identifying units of measurement
- Independent probability
- Multi-step worded problems

English Review (Grade 1)

- Phonemes
- Phonological awareness
- Syllabication
- Writing lower case alphabet
- Spelling rule application
- Morphology
- Reading irregular words
- Punctuation identification
- Fluency
- The Writing Revolution skills practice

2. Teach the review

By necessity, reviews need to be delivered at a fast pace. This is important for a few reasons. Pace helps with engagement, as you rarely give students any downtime for them to chat to their neighbours or generally muck around. A quick pace also ensures that you can cover the requisite topics of your review in 20-25 minutes.

When a topic is in a review for the first time, it's beneficial to read a definition or walk through examples together as a class before getting students to work independently. As a topic is covered more and more, you can start to remove these

scaffolds. This will allow you to speed up the pace of the review, and will also help you identify those students who have committed the information to long-term memory (while also allowing you to assist those who haven't).

Once reciting a definition or working through an example, you should then give your students a chance to demonstrate their knowledge with some questions that they can complete independently. They can use their mini whiteboards for this, allowing you to check their progress in real-time. After a while, you will become expert in knowing which students will need a bit of extra help, and who can be left alone to crack on.

3. Review the Review

Make sure that you adjust the contents of your reviews regularly, in order to take advantage of *spaced* and *retrieval practice*. If your students are consistently nailing a set of questions, then take them out for an extended period. Likewise, if your students are struggling with something that was due to be taken out of your review, leave it in for a bit longer to allow them the benefit of extra exposures. If you work with other teachers in the same year level or subject, you can discuss strong and weak topics and make changes together.

4. Considerations for students with learning difficulties

It is crucial that you design your Daily Reviews to cater for those with learning difficulties. Here are some ways to do just that:

- Design independent questions to ramp up in difficulty. Students who are more capable can race to the harder material, while ensuring that every student has accessible content to engage with.
- Be economical with text on your slides, and don't expect struggling readers to read huge paragraphs. If having a lot of text is unavoidable, then read the material aloud for students who need it.
- Check in regularly with students who need extra help while the rest of the class are working. You can nudge them in the right direction or walk them through another example.
- Create a culture of mistakes. Often, students who are not confident about their work will avoid doing it. Instead, remind students that their effort matters more than their outcome, and that no one is ever judged for

making a mistake. My review slides are totally infested with mistakes, and when I point them out it gives students implicit permission to make their own.

Conclusion

I first began using Daily Reviews in earnest in 2018, and I was blown away by the benefits I saw in my classroom. My students remember more than I ever thought was possible, and I am now very comfortable sending them off to Grade 5 knowing that they will build on what they learned this year.

Daily Reviews can take a bit of work to get off the ground, but I can assure you that the advantages far outweigh this cost. I can also help you one last time (and put in a totally shameless plug at the same time). If you follow me on Twitter ([@DaveMorkunas](https://twitter.com/DaveMorkunas)), you will gain access to several templates I have created for teachers to begin their own review decks. These are not a substitute for creating your own slides, but they will help you to understand the basic idea and flow of our Daily Reviews.

In addition to this, if you search for either mine or LDA's YouTube channel, you will find the webinar I recently presented on this topic, which runs through a few example slides. Should you have any questions, my Twitter DMs are always open.

The last few years have seen an explosion of research about the role that memory has in learning. We can leverage these ideas from cognitive science in our classrooms to help ensure that our students remember what they have been taught for longer. Whether you choose to become a member of my ever-growing PowerPoint cult or choose to forge your own path for Daily Reviews, your students will reap the benefits.

References

- Kirschner, P. A., & Hendrick, C. (2020). *How learning happens*. Routledge.
- Weinstein, Y., & Sumeracki, M. (2019). *Understanding how we learn*. Routledge.

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