

Beyond retrieval to richer forms of consolidating knowledge and strengthening learning.

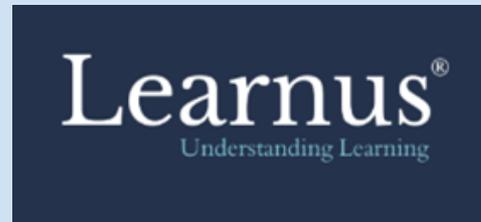
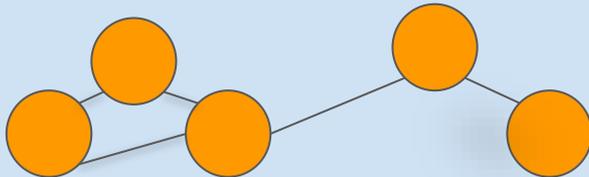
Abstract:

“Retrieval practice” is becoming a key element of the pedagogy of many teachers. However further investigation suggests its use is often limited to ‘mini-tests’ or similar activities requiring only recall of ‘facts’. Although this has benefits there is much more that can be achieved through a better understanding of the principles (drawn from cognitive science) involved and the use of a wider range of strategies and well-focussed activities. This webinar will explore some of the issues and give practical examples of how “retrieval practice” can be improved using richer forms of consolidating knowledge and strengthening learning.

Beyond 'retrieval' to richer forms of consolidating knowledge and strengthening learning.

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Overview

- What do we mean by “retrieval practice”?
- What do we know about “retrieval practice”?
- What do we want to achieve by using “retrieval practice”?
- What’s “going on” in the brain?
- What does this mean for our pedagogy?

What do we mean by
“Retrieval Practice”?

Retrieval Practice

Bring information to mind from memory

(Weinstein et al 2019)

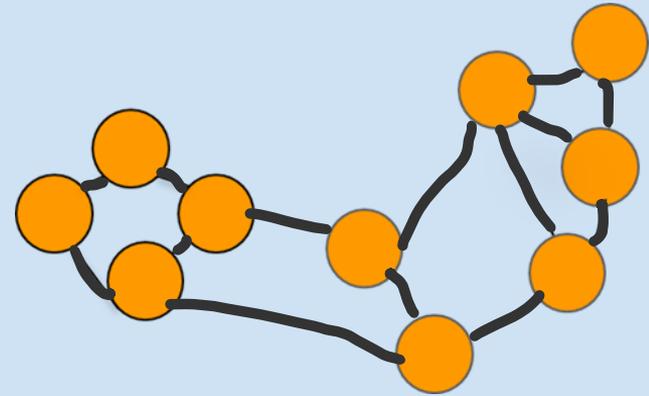
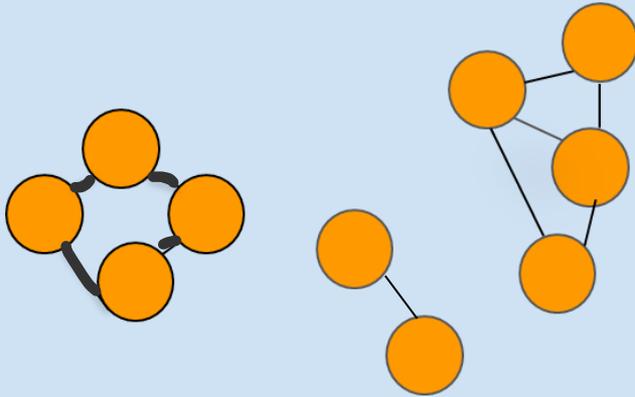
‘refers to the act of recalling learned information from memory (with no or little support)’

(Jones 2019)

the ‘testing effect’ (testing is better than restudy for retaining information in long term memory)

(Roediger and Karpicke 2006)

The value of retrieval 'stems from building new pathways of associations, closing gaps in knowledge and adjusting existing knowledge to current context'. (Furst 2019)



See Efrat Furst's [webpages](#)

Meaningful connections to other pieces of knowledge & Reconstruction by retrieval

A wide variety of activities are seen as retrieval practice

multiple-choice questions

short-answer fact questions

short problem solving (for example, solving simple sums)

true/false questions

error spotting

labelling diagrams

image recognition

recitation of quotes or definitions

list creation

Sherrington and Caviglioli (2020)

However, the most common current application of retrieval practice is using **low-stakes quizzes** to encourage learners to retrieve information for long term memory

Are low stakes quizzes the best way to do retrieval?

What do we know about
“Retrieval Practice”?

EEF Review of Cognitive Science Perry et al (2021)

The overall evidence is positive for retrieval practice.

BUT

- not many studies were carried out by teachers in realistic classroom settings

AND there are questions about

- complexity of learning suitable for retrieval practice *
- reinforcing misconceptions
- links with feedback and classroom assessment
- the emotional aspects of the success (or not) of retrieval

Does retrieval practice work for learning with high complexity as well as factual recall?

“encouraging, but not conclusive” (Perry et al 2021)

Format (e.g multiple choice quiz or short answer questions) doesn't seem to matter (Weinstein et al, 2016; Sumeracki & Weinstein 2018)

Mixed quizzes—that included both fact and higher-order questions—increased higher-order test performance more than either on their own (Agarwal 2019)

Retrieval practice can benefit conceptual learning and applying it in problem solving (Yang et al 2021)

When high in element interactivity, a test can inhibit rather than facilitate learning (Hanham, Leahy and Sweller 2017)

Balance retrieval difficulty and success.

Regardless of the student's age, some amount of success is necessary. (Karpicke et al 2014; Kang et al 2007)

If success is below 50% prompts and scaffolds may be helpful. Use repeated retrieval, removing scaffolding (Kapler et al 2015)

We need to keep an eye on cognitive load, and how the learners are feeling about the process.

What do we want “Retrieval Practice” to do for pupils?

What do we want “Retrieval Practice” to do for pupils?

In short: consolidate knowledge and strengthen wider processes of learning thus

- making knowledge more readily available - as hooks to build other new knowledge in school and in life situations
- supporting ‘automaticity’ and ‘chunking’ of knowledge helping reduce cognitive overload
- practicing thinking skills and processes

BUT

- Minimise unnecessary stress /pressure and avoid boredom due to undue repetition



Image Desire path Metro Centric CC-BY-2.0

So what is going on in the
brain?

So what is going on in the brain?

The brain is a network of 'wires' not fixed unit which enables it to:

- make new connections
- strengthen useful connections
- suppress inaccurate / false connections
- bring different bits of information (via the connections) together - memories
- react and respond to different stimuli by connecting different 'modes'/brain areas - sensory, movement, purpose, emotions, speech
- adapt to changes to itself and its environment – “plasticity”

So what is going on in the brain?

Making connections

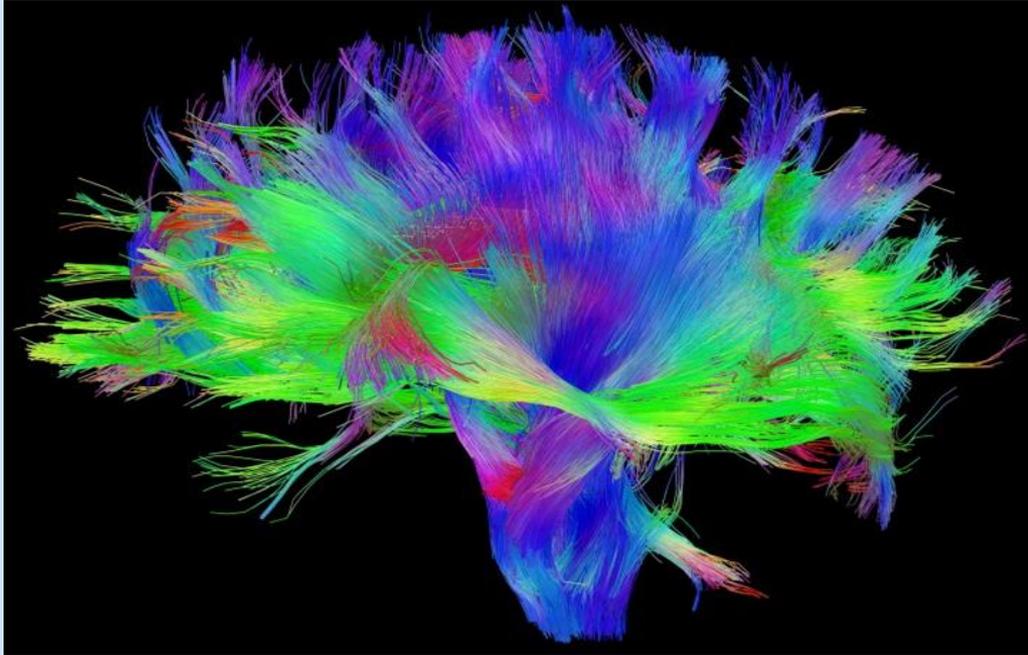
*“Cells that fire together,
wire together”*

Hebbian association



Credit: Purkinje neurons in culture. Annie Cavanagh. (CC BY-NC 4.0)

So what is going on in the brain?



‘our vast storehouse of knowledge is distributed widely in broad regions of the cerebral cortex as a network of interconnected information.’

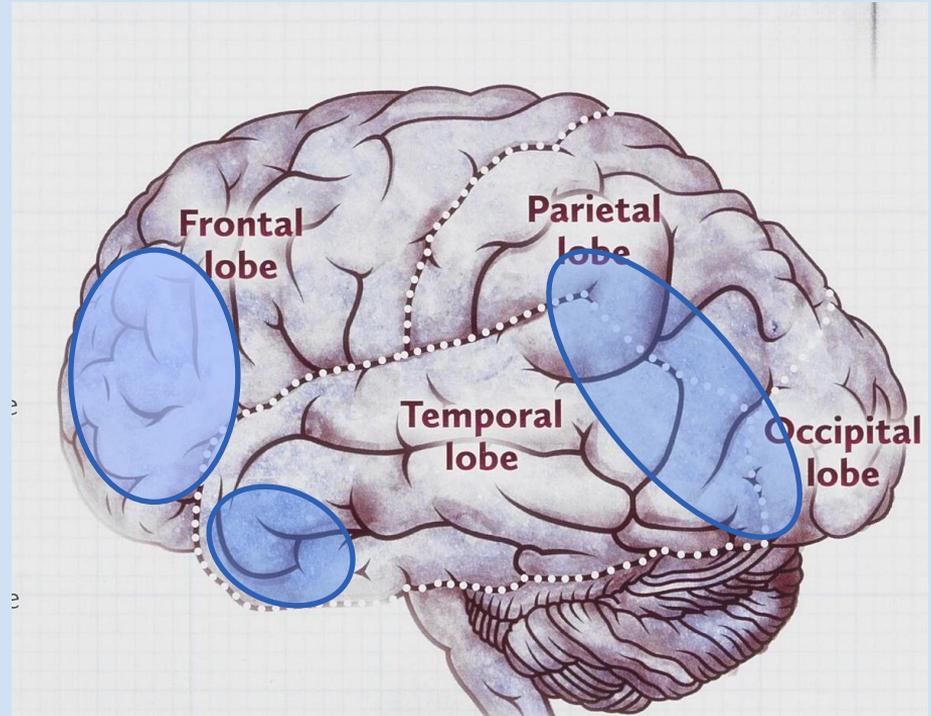
(Shimamura 2018: 22)

Image courtesy of the USC Mark and Mary Stevens Neuroimaging and Informatics Institute (www.ini.usc.edu) for the Human Connectome Project

So what is going on in the brain?

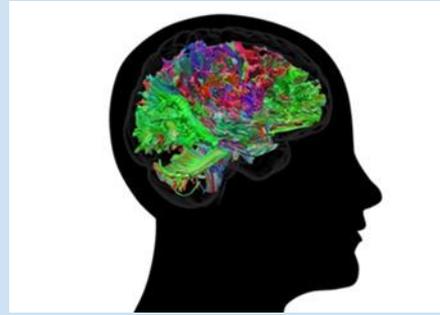
Association areas are where:

- different senses are combined to make recognition/memory easier
- attention is shifted
- planning occurs
- things are learned, stored and reconstructed (remembered)



Credit: Inside the brain / Wellcome Trust. Wellcome Collection.
Blue circles added indicate major areas of association cortex

So what is going on in the brain?



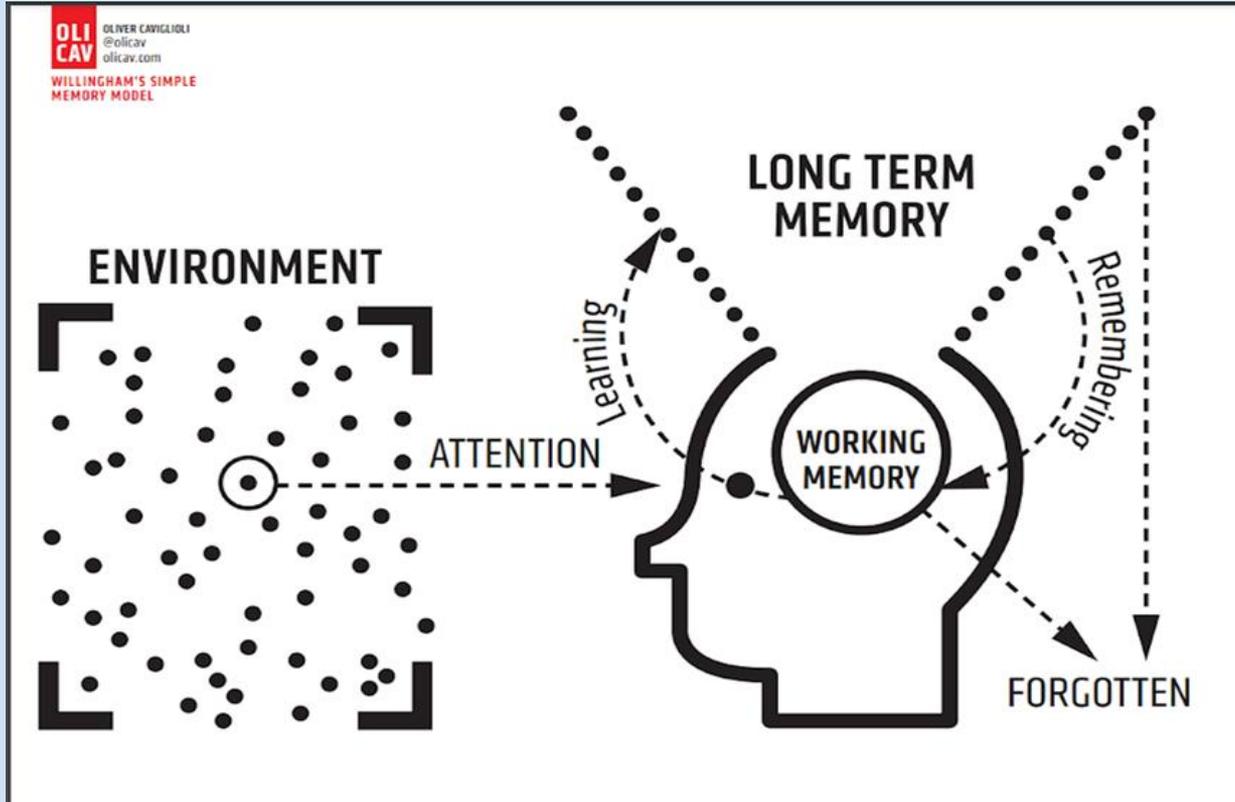
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Conceptual learning requires:

- activation of pertinent information in working memory
- binding of that information
- **memory consolidation** that is, reactivating and relating new information into existing knowledge networks stored in the cerebral cortex.
(Shimamura 2018)

Consolidation is crucial

So what is going on in the brain?



Caviglioli:
Willingham's
Simple memory
model see
<https://www.olicav.com/#/powerpoints/>

So what is going on in the brain?

Building memory:

- helps reduce overload
- consolidate ideas /information in order to build into long term memory
- make sense of information as the brain needs to know what to forget - we only need to remember information that we use often or that has special significance)
- Minimise the energy demand of brain processing bringing things together and making sense of things

Reminder: a memory isn't stored as a single item, essentially 'memories' are 'reconstituted' every time they are brought to the fore.

So what is going on in the brain?

Large number of processes that among other things include strengthening memory and improving reasoning skills which involve:

- Recalling - existing knowledge
- Elaborating - improving details of idea / knowledge
- Extending - increasing range of things to which the ideas and knowledge apply
- Applying - ideas and knowledge to new situations, places and things
- Initiating - new ideas to different contexts, problem-solving etc.
- Suppressing - unhelpful / wrong ideas - misconceptions

What does this mean for our
pedagogy?

The Learning Scientists' advice for pupils

<https://www.learningscientists.org/retrieval-practice>

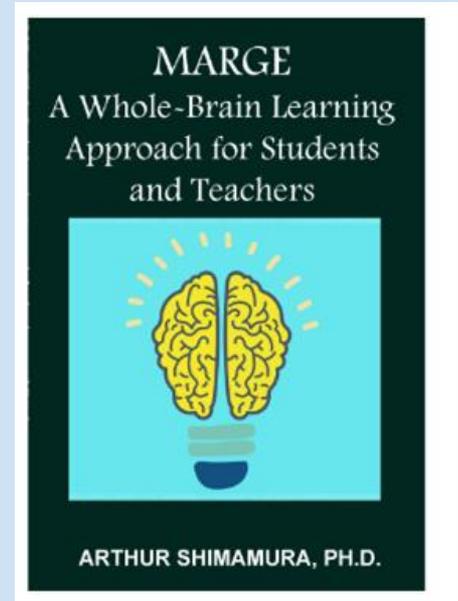
- Put away books etc and write down everything you know
- Do practice tests
- Use flash cards but go beyond definitions by thinking of links between ideas
- Don't only recall words and definitions, Make sure to recall main ideas, how things are different from one another and new examples
- Works best when you check your accuracy
- Retrieval is hard!

In our teaching we can give attention to:

- Identifying key ideas for retrieval and elaboration
- Children's talk and time to think
- Support for organising and linking ideas
- Support for transferring ideas from one context to another
- Checking and feedback

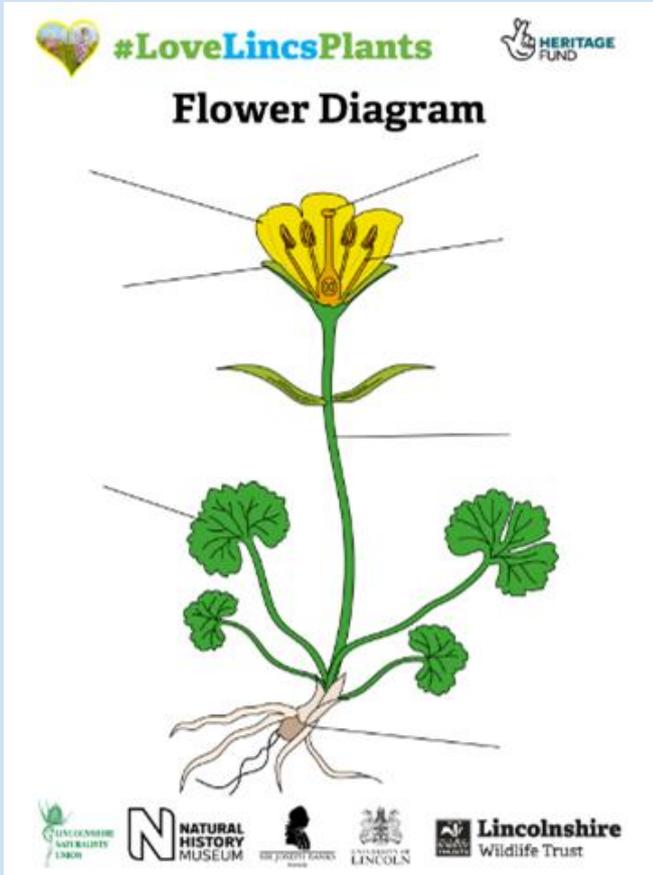
Beyond Retrieval...5Cs and a Q

Compare
Contrast
Categorise
Connect
Create
&
Question

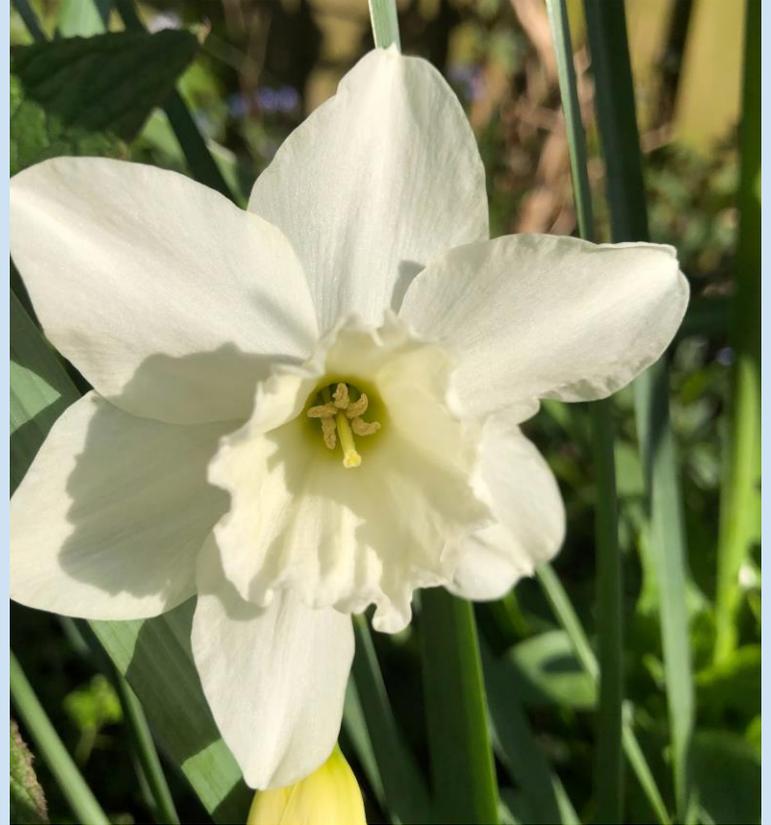


Inspired by [MARGE - A whole brain learning approach](#) [Shimamura 2018](#)

Compare: parts of a plant



Compare & Contrast: flowers



Categorise:
leaves



Connect!



Create:

What happens
next?

Tell the story
of the last
dandelion seed



Credit: SaltySemanticSchmuck, CC BY-SA 4.0 via Wikimedia Commons

Question:

Ask 3 questions about
parts of the plant

Where...?

How...?

Why...?



Question:

Ask 2 questions about the second stanza of London by William Blake.

In every cry of every Man,
In every Infants cry of fear,
In every voice: in every ban,
The mind-forg'd manacles I hear

Hints:

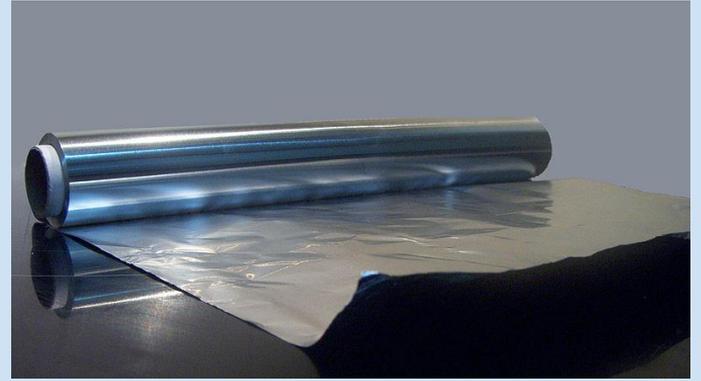
structure

rhyme, rhythm

language technique

meaning

mood



Connect!



Retrieve and elaborate
(Compare and contrast)



“ In your pairs show me three different kinds of passes we have learned ”

“Now, which is your favourite and why?”

Rich Retrieval: Working with schemas in primary science

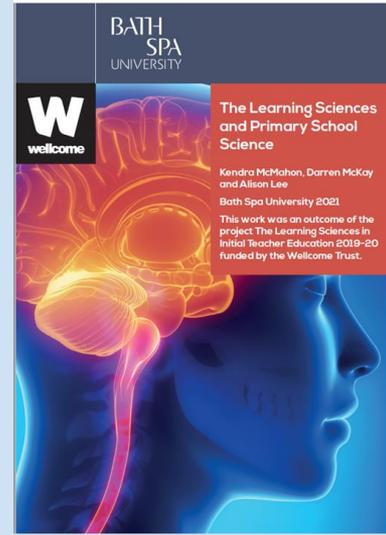
New small scale innovation project underway now to explore using 5Cs and Q as elaborative retrieval strategies in primary classrooms

Watch this space!

www.bathspa.ac.uk/learning-sciences



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Summary

Moving retrieval to richer forms of consolidating knowledge and strengthening learning.

Retrieval is about more than just recall

Retrieval practice strengthens connections

Retrieval practice can build new connections

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Other photos of flowers by Kendra McMahon