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VET PD: The Science of Learning



Test

1. What do we mean by 'retrieval practice'?
2. What is 'spaced practice'?
3. What is 'varied practice'?
4. What is the 'generation effect'?

*Answer privately - **not** in chat - no need to share your answer.*

Actually try to answer - even if you don't know.

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Overview

Interrupt forgetting with spaced practice

The power of retrieval practice

Testing as a learning tool

Generation effect

Varied practice

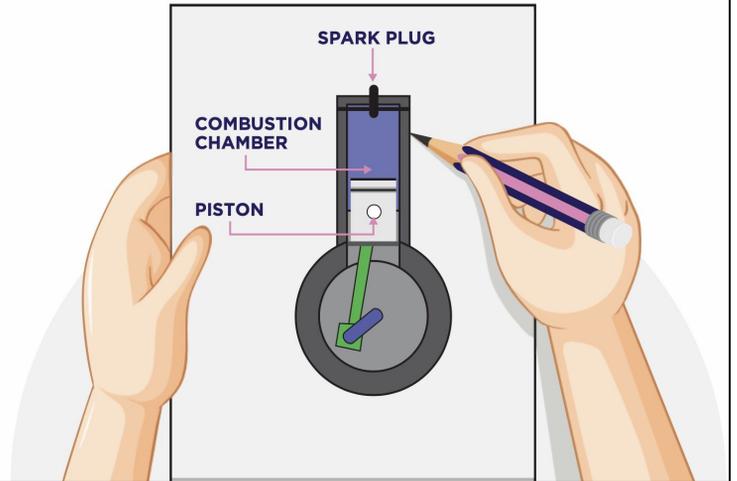
Interleaving

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Confirmation bias

“Oh learning *IS EASIER* when
I learn visually...”

I MUST be a visual learner!”



Beware confirmation bias, both in your own Professional Development, and as you support your learners on their journey.

Be open to evidence that places you in the discomfort of being a little wrong about something.



Learning Styles

“I’m a Visual/Auditory/Kinaesthetic Learner” etc.

No evidence to support this widely accepted theory.

(Yes most of us have preferences... but...)

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Most of us have ‘preferences’ for learning. E.g. it ‘feels’ easier to learn a certain way. But it may not be doing us any favours restricting ourselves to that style. Also, there is certainly a case for an instructional style matching the subject. E.g. Visual in a life drawing class, auditory in poetry.



Learning

Short term memory → Long term memory

Effortful and takes time

“Interrupting forgetting”

Push for easy, fast

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There is a push for learning to be fast and easy. We are often taught to ‘cram’ to ‘study the text.’

The path to true mastery is better spaced over time and may even feel like it’s difficult, uncomfortable and ‘not working.’

Learners need to ‘interrupt forgetting’

Practice, practice, practice?

'Seems to work'

Rapid gains = Rapid forgetting

Rising familiarity = illusion of mastery

"Massed" practice



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Practice

Spacing, varying and interleaving practice ^{[4][5]}

= better mastery, longer retention, increased versatility.

Requires effort.

Feels slower and harder.

Memorising facts is like stocking the construction site with supplies ^[5]

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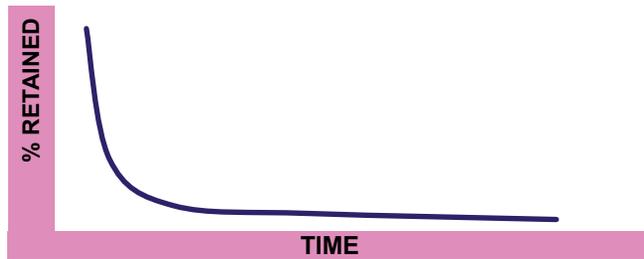
Studies even showed students who had proven better results from spaced practice believed they still learned better when it was 'massed' - even though the truth was contrary to that belief.

In spaced, varied and interleaved practice you don't get the rapid improvement and affirmations you're used to in massed practice. It feels harder, less comfortable.

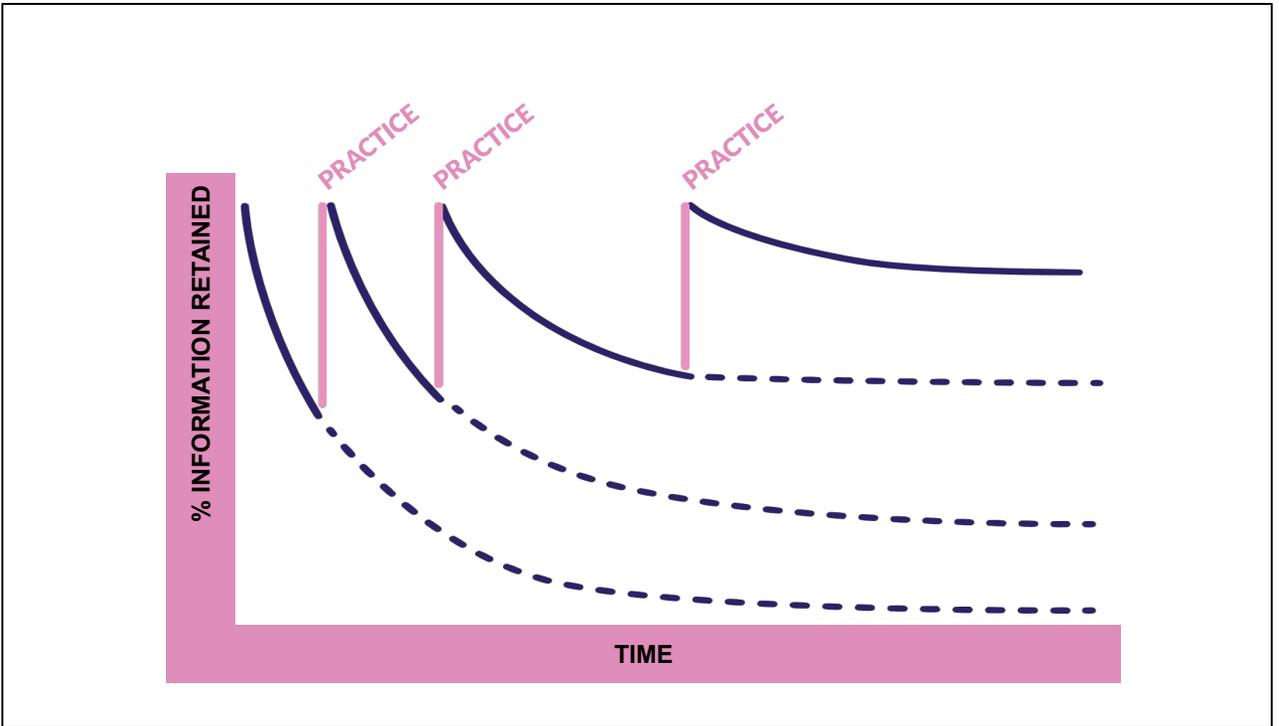
Interrupting Forgetting

The “Forgetting Curve” (Ebbinghaus circa 1880)

Successfully reproduced in 2015 [1] (and others)



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Note the spacing of practice increasing over time, and the forgetting curve 'smoothing' over more practice.



How can you assist your students in ‘interrupting forgetting’?

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Someone commented that it's like “writing in the sand” there one moment and gone the next.

Varied Practice

Bean bag toss experiment 1978 [2]

Reproduced numerous times with skilled and cognitive learning



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Strong evidence it's beneficial.
No evidence that it's detrimental.



An example of something you
learnt where your practice was
varied?

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SPACED PRACTICE

Facilitate spreading learning activities out over time.

MON	TUE	WED	THU	FRI
Blue	Green	Red	Blue	Green
Red	Blue	Green	Red	Blue
Green	Red	Blue	Green	Red

INTERLEAVING

Switching between topics while learning.

INTERLEAVING	Blue	Green	Blue	Green	Red	Blue	Green	Red
BLOCKING	Blue	Blue	Blue	Green	Green	Green	Red	Red

Retrieval Practice

Bringing learned information to mind from long-term memory.





Retrieval practice

How do we 'use' learning in the real world?

Retrieving what you've learned causes the brain to 're-consolidate'

Interrupts forgetting

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Resistance/anxiety with tests - I want to be "ready"



Testing

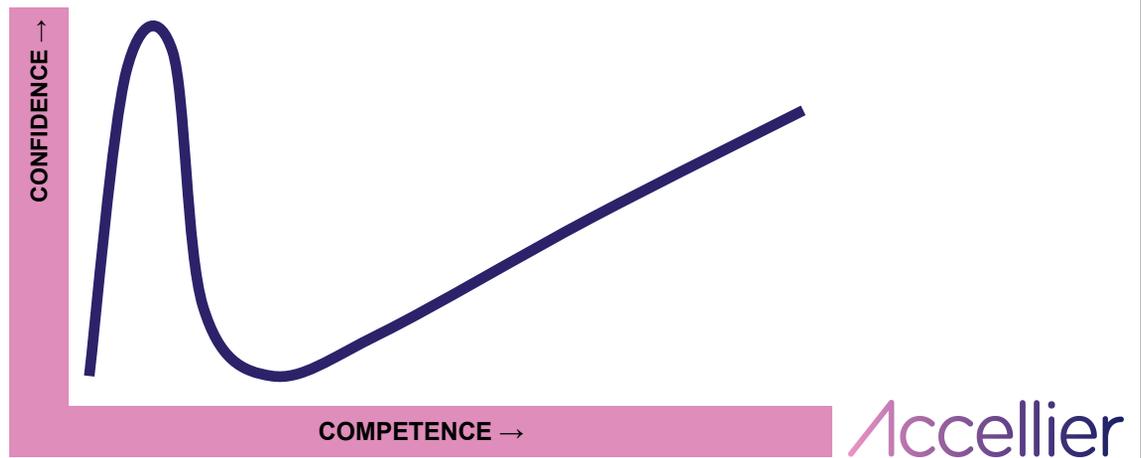
A powerful long-term memory retrieval tool

Helps 'calibrate' against illusions and bias

Highlights what you don't know → focus efforts

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Dunning Kruger Effect



Mount stupid
Valley of despair
Note the expert's confidence level?



Generation

Attempting to answer questions/solve problems before being taught

Better to solve a problem then memorise a solution

Better to be incorrect than not make the attempt

“Unsuccessful attempts encourage deep processing and create fertile ground for encoding in a way that simply reading the answer cannot.” [5]

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Examples of how you can use
retrieval practice and
generation with your students?

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Meet Nick.

*My own experiments
with varied, retrieval,
generation, interleaving,
spaced practice.*

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Story of Paul's mate Nick the Naturalised.

Paul practices his own program of retrieval practice, interleaved and spaced practice with 'generation' - Nick quizzing Paul on a plant even if he didn't know the answer. It's uncomfortable, but Paul felt the learning seems to stick better as he gradually learns rainforest plant species.



Recap

As students, we're not always the best judge of when things are going well.

We draw to seemingly more fruitful strategies, unaware the gains may be temporary.

Harder, effortful learning is deeper and more durable.

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Recap

Spaced and interleaved practice assists with long term memory and durability of memory, and mastery (forgetting curve).

Trying to solve a problem before being taught leads to better learning (even if you get it wrong).

No evidence for 'Learning Styles' – it may be detrimental.

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Are you willing to try your own spaced,
interleaved, retrieval practice?

Exercises here:

<https://docs.google.com/document/d/1M8hfOltSMOurl3F3emq-rS6gbueUBymz7c7sWIYRZ3g/edit?usp=sharing>

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<https://docs.google.com/document/d/1M8hfOltSMOurl3F3emq-rS6gbueUBymz7c7sWIYRZ3g/edit?usp=sharing>



References

[1] Murre JMJ, Dros J (2015) Replication and Analysis of Ebbinghaus' Forgetting Curve. PLOS ONE 10(7): e0120644.
<https://doi.org/10.1371/journal.pone.0120644>

[2] Kerr and Booth. Specific and varied practice of motor skill. *Perceptual and Motor Skills*, 46 (1978), pp. 395-401

[3] Chéla R. Willey, Zili Liu, Long-term motor learning: Effects of varied and specific practice, *Vision Research*, Volume 152, 2018, Pages 10-16.

[4] Weinstein, Y., Madan, C.R. & Sumeracki, M.A. Teaching the science of learning. *Cogn. Research* 3, 2 (2018), accessed from
<https://doi.org/10.1186/s41235-017-0087-y>

[5] Brown, Peter C. *Make It Stick : the Science of Successful Learning*. Cambridge, Massachusetts :The Belknap Press of Harvard University Press, 2014.

There were vague references mentioned in the live session to a range of other studies, many of which can be found in [5] also a great 'entry' point into many other studies mentioned is Zach Groeschel's blog 'Education Rickshaw' :
<https://educationrickshaw.com/2021/09/06/is-there-a-science-of-learning-and-what-is-in-it/>



