Lecturio

Spacing and Interleaving for Better Learning

October 20, 2021
Online Seminar

Seminar Learning Outcomes

1. Participants will be able to **recognize** the educational value of "desirable difficulties" in strategies like spacing and interleaving.
2. Participants will be able to **understand** the cognitive science and neuroscience evidence that support the educational strategies of spacing and interleaving.
3. Participants will be able to **describe** the utilization of spacing and interleaving from both the educator's and student's perspectives.
4. Participants will be able to **apply** the approaches of spacing and interleaving to their medical curricula.

When Difficulties Are Desirable

Challenging Workouts Are the Norm for Athletes

- A common motto in athletic training is “no pain, no gain.”
- This is analogous to *desirable difficulties* in academics.

Image: https://www.wikihow.com/Do-Sit-Ups

Spacing for Better Learning

2

Poll

Are you familiar with spacing as a learning strategy and its potential to improve learning?

If you are familiar with spacing, do you find it easy to utilize the practice in your teaching?

Spacing in Medical Education

- Spacing is the evidence-based and very effective educational strategy of spreading learning out over time with “rest" periods in between.
- Allowing rest time in between studying allows for consolidation in the brain to occur, making learning more durable—contrary to the case with traditional massed practice.

Why Spacing Works

Insights from cognitive science:

- Spacing improves encoding variability.
- Recurring reminding through spacing may increase recollection.
- Spaced learning may provide multiple retrieval routes and improve the availability of knowledge in long-term memory.

Insights from neuroscience:

- Spacing allows time for consolidation.
- Consolidation strengthens some neural links while pruning others.
- Sleep and rest allow for critical hippocampal involvement in the consolidation process.
- Rest periods can be short, but executive function cannot be engaged if rest is to be effective.

Evidence for Spacing in Medical Education

- Spaced learning is the opposite of “cramming” and produces better long-term knowledge retention.
- Remember that optimal interstudy time must be long enough to allow some forgetting to occur.

Moulton C-AE, Dubrowski A, MacRae H, Graham B, Grober E, Reznick R. Teaching Surgical Skills: What Kind of Practice Makes Perfect?: A Randomized, Controlled Trial. Trans Meet Am Surg Assoc. 2006;124:66–75.

Implementation of Spacing: Practical Recommendations

Educator's perspective:

- When teaching students how to do a procedure, allow for periods of time in between practice over multiple days instead of massing practice in one sitting.
- When teaching a specific topic, consider presenting the material over several days to allow time for reflection and consolidation.
- Keep spacing in mind when designing curricula.

Student's perspective:

- Inform students that spaced practice is a better utilization of limited study time.
- Spacing can be enhanced by technological resources—encourage students to use them.
- Remind students that the perception of lower competency which may accompany spaced practice is offset by superior long-term retention of knowledge.

Interleaving for Better Learning

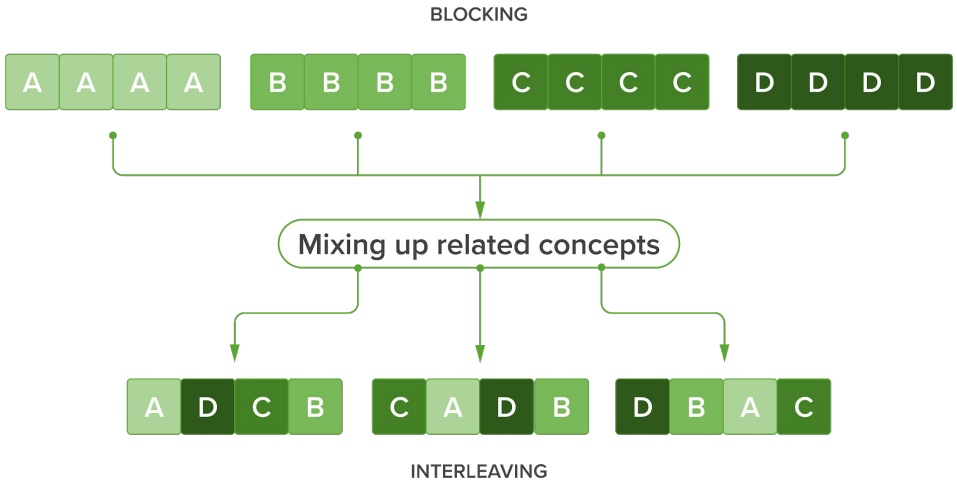
3

Poll

Are you familiar with interleaving as a learning strategy and its potential to improve learning?

If so, do you encourage your students to utilize interleaving in their learning?

Interleaving Is an Efficient but Underutilized Learning Strategy



- Interleaving is an evidence-based practice of varying or mixing up concepts that are being taught/learned, as opposed to studying them in a blocked fashion.
- Interleaving has been shown to be very effective and results in the establishment of more durable learning.

Why Interleaving Works

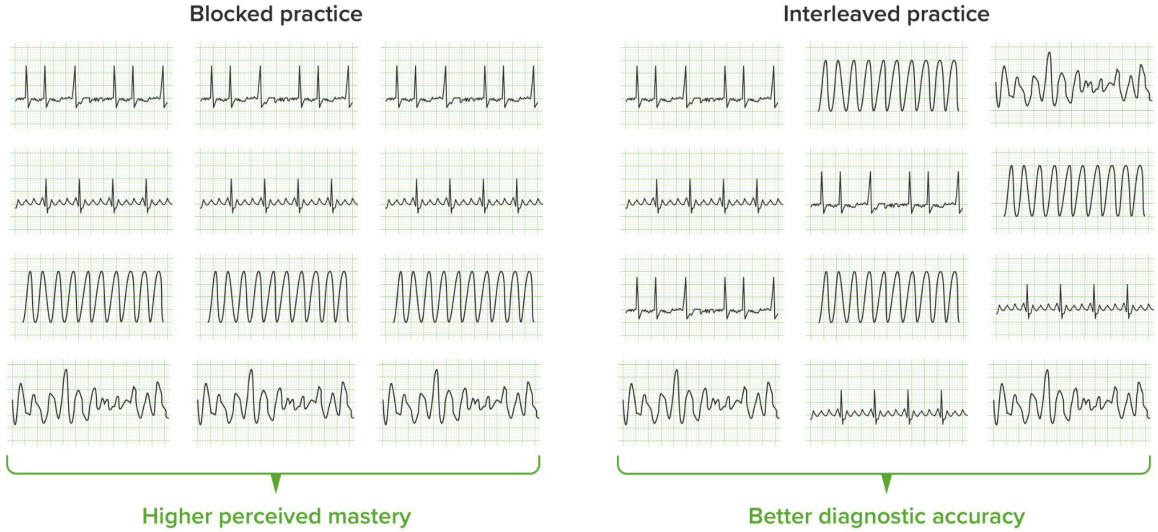
Insights from cognitive science:

- Interleaving is thought to diminish attention attenuation, in which repeated examples that are too similar will result in fading attention.
- Interleaving may enhance discriminative contrast, which is the ability to compare and contrast between similar concepts.

Insights from neuroscience:

- Interleaving may assist with long-term retention of knowledge by establishing more durable connections along neural pathways.
- Interleaving requires differentiation between concepts and is particularly important in augmenting procedural memory.

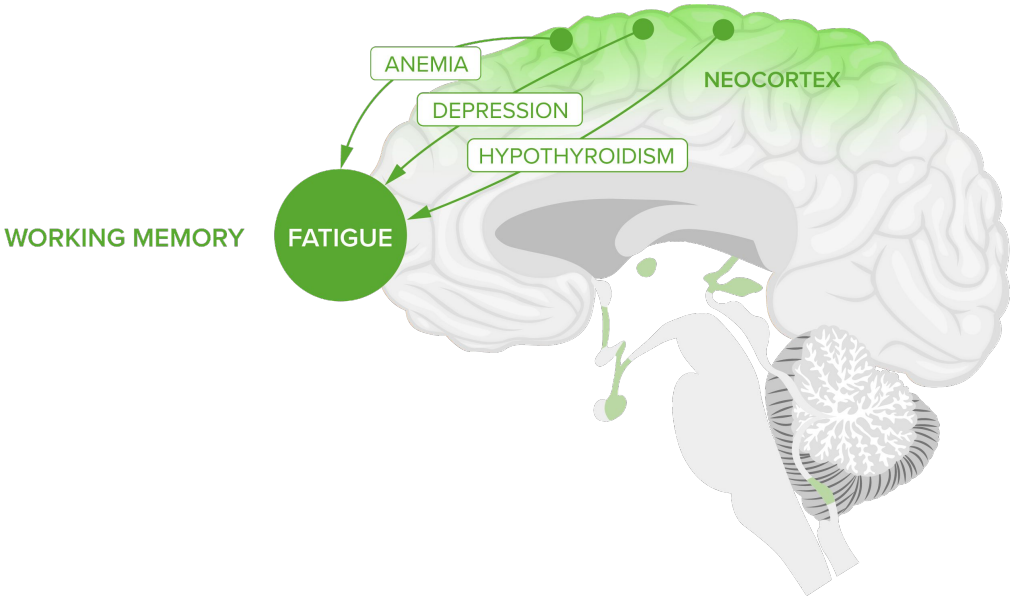
Evidence for Interleaving in Medical Education



- Acquisition of ECG interpretation skills was better in students who used interleaving practice (46% accuracy) compared with those who used blocked practice (30% accuracy).
- More studies show that learners who practice with interleaving have better knowledge retention and application of learned concepts to new contexts.

Kulasegaram K, Min C, Howey E, Neville A, Woods N, Dore K, et al. The mediating effect of context variation in mixed practice for transfer of basic science. Adv Health Sci Educ. 2015 Oct 1;20(4):953–68.

Example of Interleaving in Medical Education



- Interleaving can be an effective strategy to help medical learners connect distinct, yet similar schemas in medicine.
- Creating a differential diagnosis is a classic way of applying interleaving.

A Word of Caution

In order for students to interleave effectively, they must first have a good understanding of the material they are expected to compare and contrast.

Desirable Difficulties in Sports Training – Adopt for Academics

- Modern batting practice effectively uses spacing and interleaving.
- Batters who practice with *different and varied* pitches do better in games than batters who are trained to hit the same style of pitches over and over.

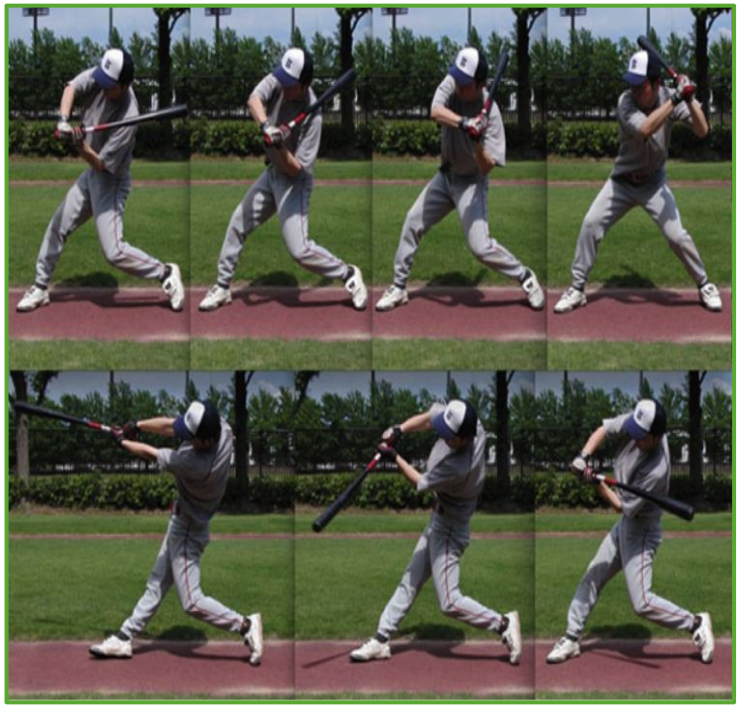


Image: https://www.southbat.com/blog/2017/7/13/batting-practice-why-you-should-be-practicing-with-a-wood-bat

Surgical Example: Learning Knot Tying With Interleaving

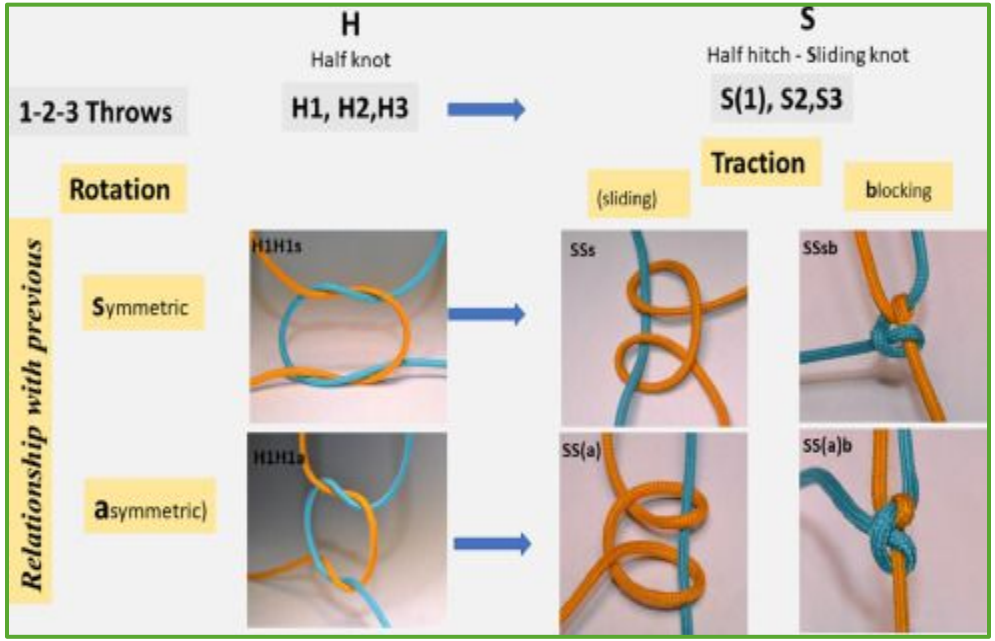


Image: https://www.jmig.org/article/S1553-4650(19)31209-9/fulltext

Implementation of Interleaving: Practical Recommendations

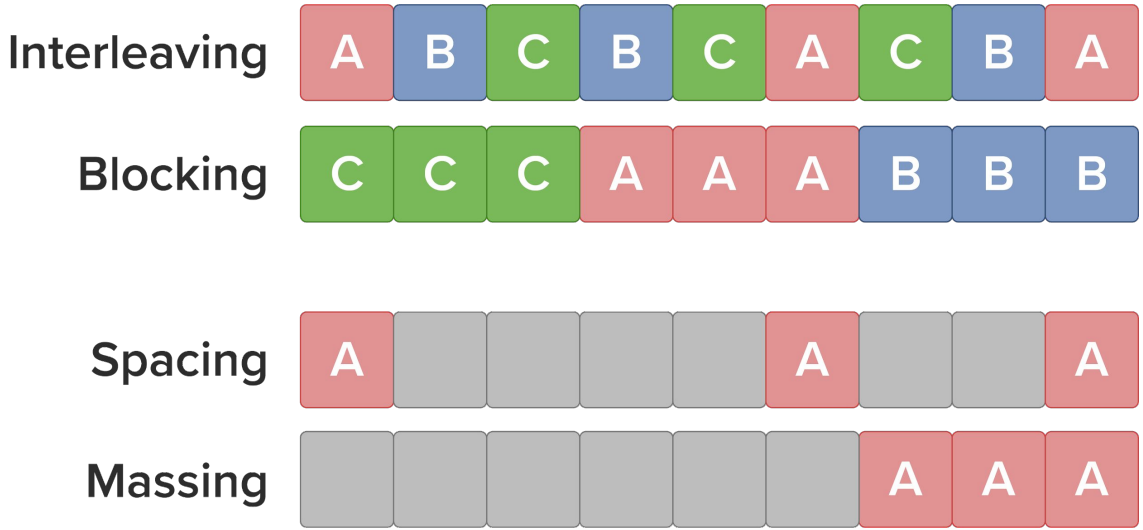
Educator's perspective:

- As interleaving is successfully used in sports training, it can be applied to medical procedural training.
- A case-based approach inherently leverages interleaving and is an important element to incorporate in curricular design.
- A spiral curriculum—repeating key concepts throughout a course of study with deepening complexity—presents unique challenges and opportunities to incorporate interleaving.

Student's perspective:

- Students can group topics into related clusters and practice with flashcards/question bank exercises/review topics.
- Students need to understand that interleaving will seem more difficult than blocked practice, but will lead to more durable learning and thus be the best use of their limited study time.

Differentiating Between Spacing and Interleaving



- Interleaving always involves spaced practice, but spaced practice can be achieved without interleaving.
- Research indicates that combining interleaving and spaced practice results in better learning outcomes than does spaced practice alone.

Image: https://www.researchgate.net/figure/a-Blocked-practice-and-interleaved-practice-with-fraction-problems-In-the-blocked_fig6_321667981

Using E-learning Platforms

To Make the Most of Interleaving & Spacing

- Learning platforms can simplify the administration of strategies such as interleaving and spacing by presenting material for review at intervals designed to optimize retention, according to an algorithm, based on accuracy and self-perceived confidence.
- Students and faculty can choose the intervals at which material is covered/reviewed, and students can practice with different yet related materials to gain an interleaved and spaced effect.

Takeaway

- Spacing and interleaving involve “**desirable difficulties**” that can improve retention of knowledge in long-term memory.
- Spacing and interleaving techniques are especially effective in enhancing **procedural learning** in medical education.
- **Technology** can greatly facilitate the implementation of these important learning strategies.

Contact us

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