"Leave" Them Thinking: Using Interleaving to Promote Retention in a Capstone Review Course

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Session Objectives

At the successful completion of this unit, the participant will be able to:

- Compare the principles of massed versus interleaved practice as applied to instructional design.
- Design a unit of instruction which incorporates methods of interleaving.
- Assess the instructional efficacy of and student preferences for a unit of instruction which utilizes interleaved practice.

Poll Everywhere Survey

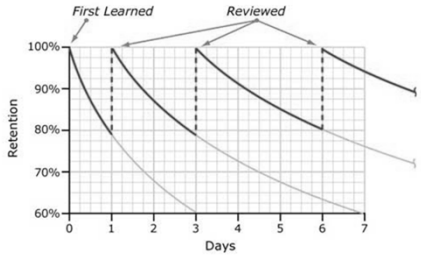
Student Survey

What is **Practice**? **How** do we **Practice**?

✗ practice, practice, practice

✔ practice……practice……practice

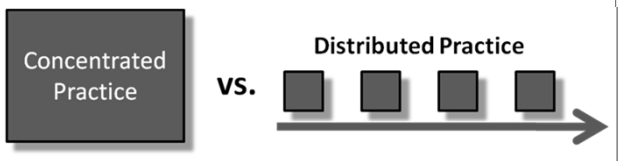
Typical Forgetting Curve for Newly Learned Information



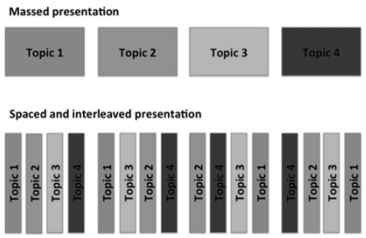
How do we **prevent forgetting**?

1. **Distribution** of material and practice during learning **[spacing and interleaving]**
2. **Frequent assessment** of learning (quizzing and testing) **[retrieval practice]**
3. **Explanatory questioning** (directed self explanation, concept mapping) **[elaboration]**

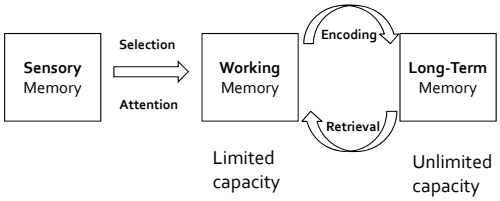
Distribution: Massed vs Spaced Practice



Distribution: Spaced & Interleaved Practice

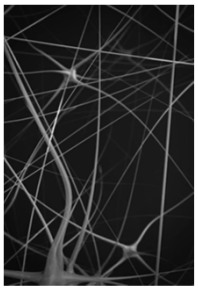


What is Retrieval?



Where is the Retrieval system?

- Neural pathways get stronger each time memory is retrieved
- Periodic practice prevents forgetting and reinforces retrieval pathways
- Creates a neural "breadcrumb trail"



What is Retrieval Practice?

- **Retrieval practice - recreating something already learned from memory**
- Formative or low-stakes testing
- Can be formal/directed or spontaneous/self-generated

What is Retrieval Practice?

- **Must have time to forget information for retrieval to be effective [time ⇒ spacing] [shift focus ⇒ interleaving]**
- Must be difficult enough and not use your short-term memory to rehearse what you just saw or heard **[desirable difficulty]**

A **desirable difficulty** is a learning task that requires a considerable but **desirable** amount of effort**,** thereby improving long-term performance.

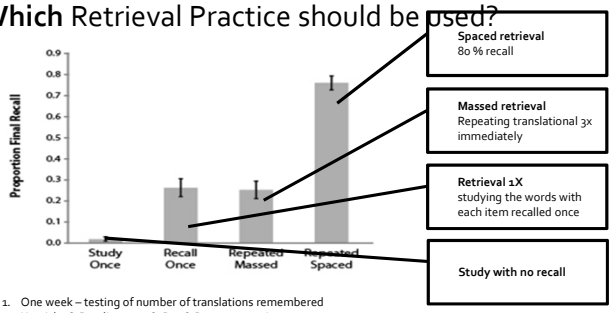
How do you provide Retrieval Practice?

- Teach students to use their **learning objectives as an initial guide** to formulate their questions. Be sure the learning objectives align with lesson activities and assessments.
- **Pretest** the students before a unit of instruction to prime the retrieval and recall process
- Provide "**summary points**" to model recall and call on students to do the same
- Incorporate frequent **low-stakes quizzing** into class structure

How do you provide Retrieval Practice?

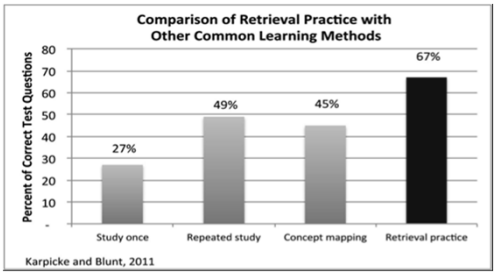
- Testing effects are best at the point of forgetting. Utilize **spacing (time) and interleaving (focused distraction)** to disengage short term memory
- **Use cumulative quizzing**. Include questions addressing previous material in each quiz/test.
- Enhance their metacognitive abilities by **demonstrating the positive benefits of self-testing** while reading textbooks and struggling with difficult concepts ("What do I know now") (What is my understanding of this information?)

Which Retrieval Practice should be used?



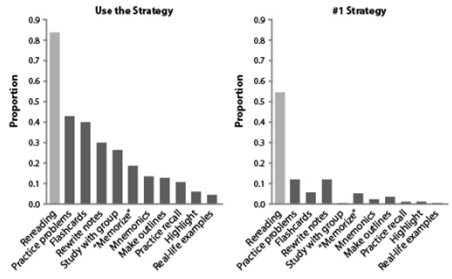
1. One week – testing of number of translations remembered
2. Karpicke & Roediger, 2008; Pyc & Rawson, 2010).

Why use Retrieval Practice?



Karpicke and Blunt, 2011

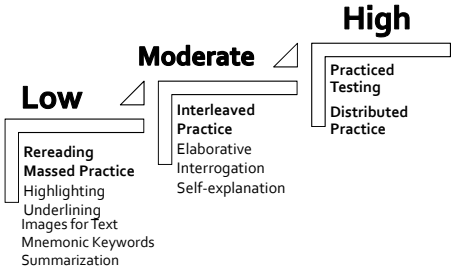
Why most don't use Retrieval Practice?



Why most don't use Retrieval Practice?

- Most students use **"Rereading" and blocked (mass) practice**
- **These techniques feel easier** and they are! Easier means less retrieval practice and less retention.
- **Reading is a very passive cognitive activity** – would need to actively engage by self-testing in order to make it more difficult
- **Student feel more successful using massed practice**. Using short term memory, gives student a false sense of "knowing" the answers because recall seems easier and more immediate

How does Retrieval Practice **compare**?



What does the research tell us?
Repeated retrieval **enhances long-term retention**

1. Retrieval significantly **improves long-term retention** (Roediger & Karpicke, 2006)
2. **Multiple testing events** provide greater benefit than a single test (Smith & Karpicke, 2014)
3. **Retrieval practice was more effective than elaborative study** with concept mapping (Karpicke & Blunt, 2011)

What does the research tell us?
Retrieval is **enhanced by different formats**

1. **No difference between MC and short-answer** questions when no feedback is given (Smith & Karpicke, 2014)

What does the research tell us?
Feedback enhances retrieval benefits

1. **Delayed feedback** result in **better** retention **than immediate feedback** (Butler & Roediger, 2008)
2. **Low-confidence** answers were **most benefited** by feedback (Butler et al, 2008)

What does the research tell us?
Retrieval benefits are **not limited to retention of retrieved information**

1. **Retrieval increased transfer** from one domain to another (Butler, 2010)
2. **Retrieval practice improves performance to other types of assessments,** specifically short answer aided concept map production skills (Karpicke & Blunt, 2011)

What does the research tell us?
More retrieval is better

1. **Pretest improve performance on final test** for pretest info and related topics (Little & Bjork, 2011)
2. **Interim testing improves recall,** for info taught **before and aft**er (Wissman et al, 2011)
3. **Daily exams improve retention better** than unit exams (Leeming, 2002)

What does the research tell us?
Repeated retrieval **enhances long-term retention**

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What populations would benefit from Retrieval Practice?

1. Face2Face students
2. Online students
3. Clinical training students

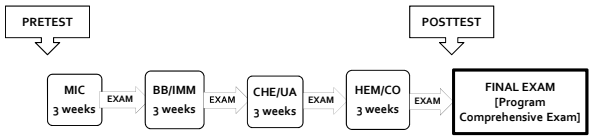
How can **students use** Retrieval Practice?

- **Use Practice tests** – as provided by your instructor or from your textbook. Do them without looking at your notes!
- **Make questions**
- **Create flashcards**
- **Use Flow of Consciousness** - write down everything you know about the subject

How can **students use** Retrieval Practice?

- **Draw pictures, graphs, tables, etc**:
- **Use as many senses as possible**
- **Make a concept map from memory,** then fill in the rest. Be sure to map the relationships between concepts
- Create a study schedule with **spacing and interleaving.**

Online Course – Capstone Review



1. Previously in place independent study practice modules in each area
2. 4 unit exams (taken twice – grade is the higher of two scores)
3. Pre-Test / Post-Test
4. Final exam (BOC equivalent comprehensive exam)
5. Final semester = Clinical Practica + Capstone Review

Online Course – Capstone Review **Interleaved**

MON	TUE	WED	THU	FRI	SAT	SUN
BAC 1		BAC 2		BAC3		MICRO UNIT EXAM
PAR 1		PAR 2		PAR 3		
MYC 1		MYC 2		MYC 3		

1. First two weeks of MIC session, student use lesson modules to study at own pace
2. For the third week, developed 3 modules consisting of a subunit of each of: bacteriology, parasitology, and mycology
3. **Interleaved subunits** with one day spacing over the week with **formative quizzes after each subunit**

Clinical Rotation – Standard Sequence

NO INTERLEAVING OR SPACING – ONE AREA AT A TIME

MIC 4 weeks ⇨ BB 4 weeks ⇨ CHE 4 weeks ⇨ HEM 2 weeks ⇨ CO 1 week ⇨ UA 1 week

Clinical Rotation – **Interleaved** Sequence

6-WEEK INTERLEAVED SPACING BETWEEN SAME AREA

MIC 2 weeks ⇨ BB 2 weeks ⇨ CHE 2 weeks ⇨ HEM 1 weeks ⇨ CO 0.5 week ⇨ UA 0.5 week

MIC 2 weeks ⇨ BB 2 weeks ⇨ CHE 2 weeks ⇨ HEM 1 weeks ⇨ CO 0.5 week ⇨ UA 0.5 week

Clinical Rotation – **Interleaved** Sequence

3-WEEK INTERLEAVED SPACING BETWEEN SAME AREA

MIC 1 week ⇨ BB 1 week ⇨ CHE 1 week ⇨ HEM 0.5 weeks ⇨ CO 0.25 week ⇨ UA 0.25 week

MIC 1 week ⇨ BB 1 week ⇨ CHE 1 week ⇨ HEM 1 week ⇨ CO 0.25 week ⇨ UA 0.25 week

MIC 1 week ⇨ BB 1 week ⇨ CHE 1 week ⇨ HEM 1 week ⇨ CO 0.25 week ⇨ UA 0.25 week

Face-2-Face – Classroom instruction

30
- Ask students to summarize info from last class
- Present objectives in the form of questions
- Give a pretest on upcoming information in lesson

20
- Present **PROBLEMS TYPE 1** – no solution key - students attempt to solve
- Give students PROBLEMS TYPE 1 + solution key (worked examples)
- Have students solve PROBLEMS TYPE 1 on their own. FEEDBACK

30
- Present **PROBLEMS TYPE 2** – no solution key - students attempt to solve
- Give students PROBLEMS TYPE 2 + solution key (worked examples)
- Have students solve PROBLEMS TYPE 2 on their own. FEEDBACK

30
- Ask students to describe outloud how they solved **PROBLEMS TYPE 1**
- Ask students to describe outloud how they solved **PROBLEMS TYPE 2**
- Give a practice **QUIZ** with mixed problem sets.

Shared Practices

- What techniques are you currently using which incorporate retrieval, spacing, and/or interleaving?
- What suggestions do you have to incorporate these techniques into F2F, online, or clinical training?

References

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Questions?

If you have further questions or an interest in participating in this area of research, please contact:

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