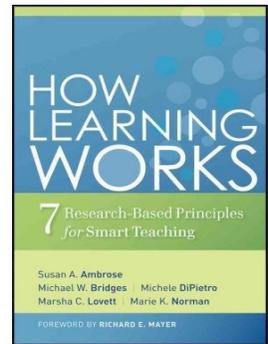
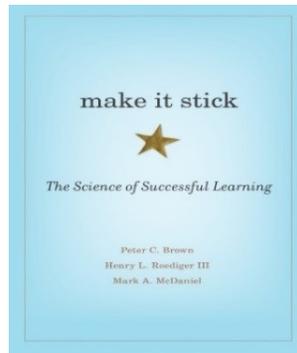
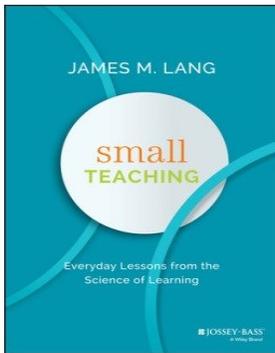


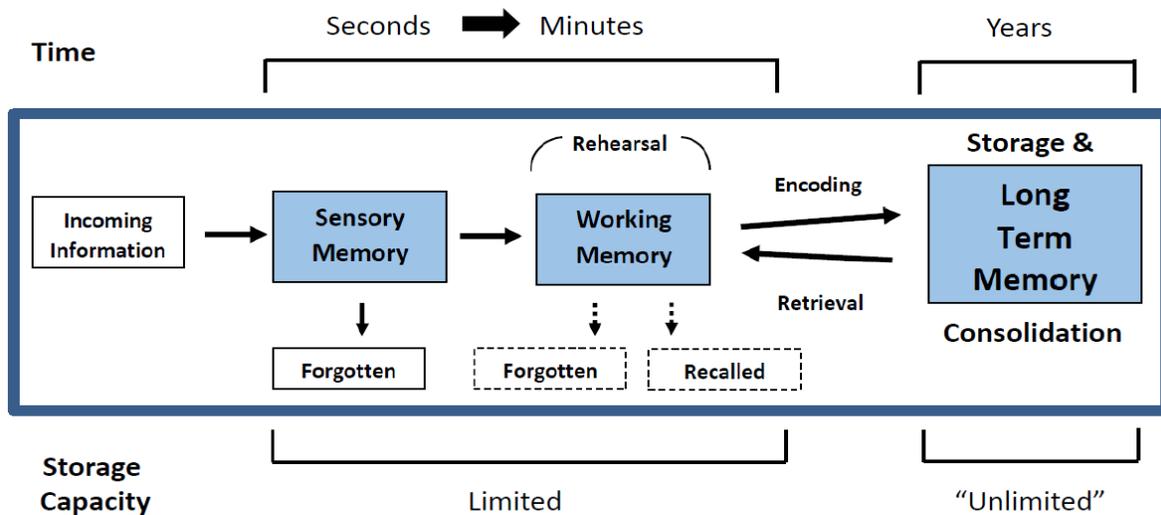
Science (or Illusions) of Learning: Building Metacognitive Learning Strategies & the Master Learner

Wednesday – February 7, 2018: Lawrence Loo, MD, MACP



Cognitive Information Processing Theory

(Mayer RE: Applying the science of learning to medical education. Med Educ 2010;44:543-9)



Learning-Oriented Teaching Model (LOT) Worksheet

(Revised 1/4/2017 – Lawrence Loo, MD)

How to get a “LOT” out of your conferences: Demonstration of the LOT Model

Learning Process Component	Learner’s Concerns	Teachers’ Concerns and Issues
Cognitive Level	Study what ?	Presenting (facilitating the provision of relevant information)
Affective Level	Why Study?	Motivating (stimulating students to invest in studying)
Metacognitive Level	How to learn?	Instructing (helping students to go about studying)

Table Adapted from: TenCate, O., Snell, L., Mann, K. & Vermunt, J. (2004). Orienting teaching toward the learning process. *Academic Medicine*, 79(3), 219-228. *Clinical implications for medical education of LOT model*: Kusrkar RA, et al.: Have motivation theories guided the development and reform of medical education curricula? a review of the Literature. *Acad Med* 2012;87:735-43.

WHAT IS OUR ROLE AS INSTRUCTORS?

What to present to learners: What are the most important points you would like learners to remember?

How to motivate learners: How will you **actively engage** your audience?

How to instruct learners: How will you create a **learning climate** to optimize learning?

STRATEGY TO IMPLEMENT

Learning goals and objectives:

-Medical Students:

-Interns/Residents:

-Faculty:

THE Myth OF Multitasking

EXERCISE #2

(Are you really multitasking ... or are you switchtasking? The following exercise will help you quickly understand the negative impact in efficiency caused by switchtasking.)

	Multitasking is worse than a lie
M	
I	
M	
I	

FIRST PASS

1. Have a timer with a second hand ready again.
2. In the third row, re-copy the phrase "Multitasking is Worse Than a Lie". After copying the entire phrase in the third row, then switch to the fourth row and write the numbers 1-27.
3. Ready, Set, Go! (After you have completed the last number (27), write down your total time to completion.)

SECOND PASS

4. Have a timer with a second hand ready. For best results have another person time you.
5. In the first row, copy the phrase "Multitasking is Worse Than a Lie". For every letter you write in the "M" row, switch to the second row (labeled "1") and write the corresponding number.

Like this:

Multitasking is worse than a lie.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
24 25 26 27

6. Ready, Set, Go! (After you have completed the last number (27), write down your total time to completion.)
7. Compare the time to completion between the first and second pass. Typically, a person will take twice as long to complete this exercise when switchtasking (second pass) vs. focusing on one task at a time (first pass).



Adapted from *The Myth of Multitasking: How "Doing It All" Gets Nothing Done* by Dave Crenshaw.

(ISBN: 978-0-470-37225-8) Copyright © 2008 by Dave Crenshaw. Published by Jossey-Bass, An Imprint of Wiley, 2008

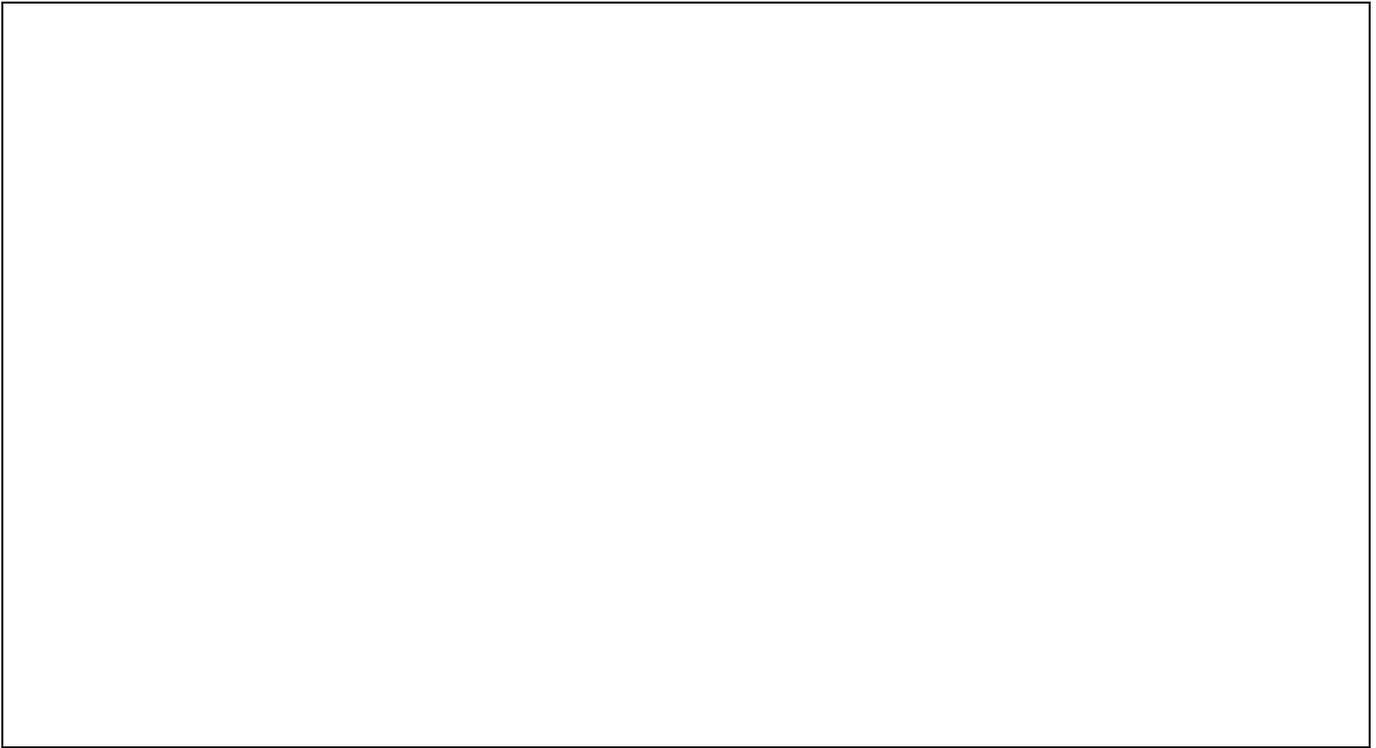


dave crenshaw

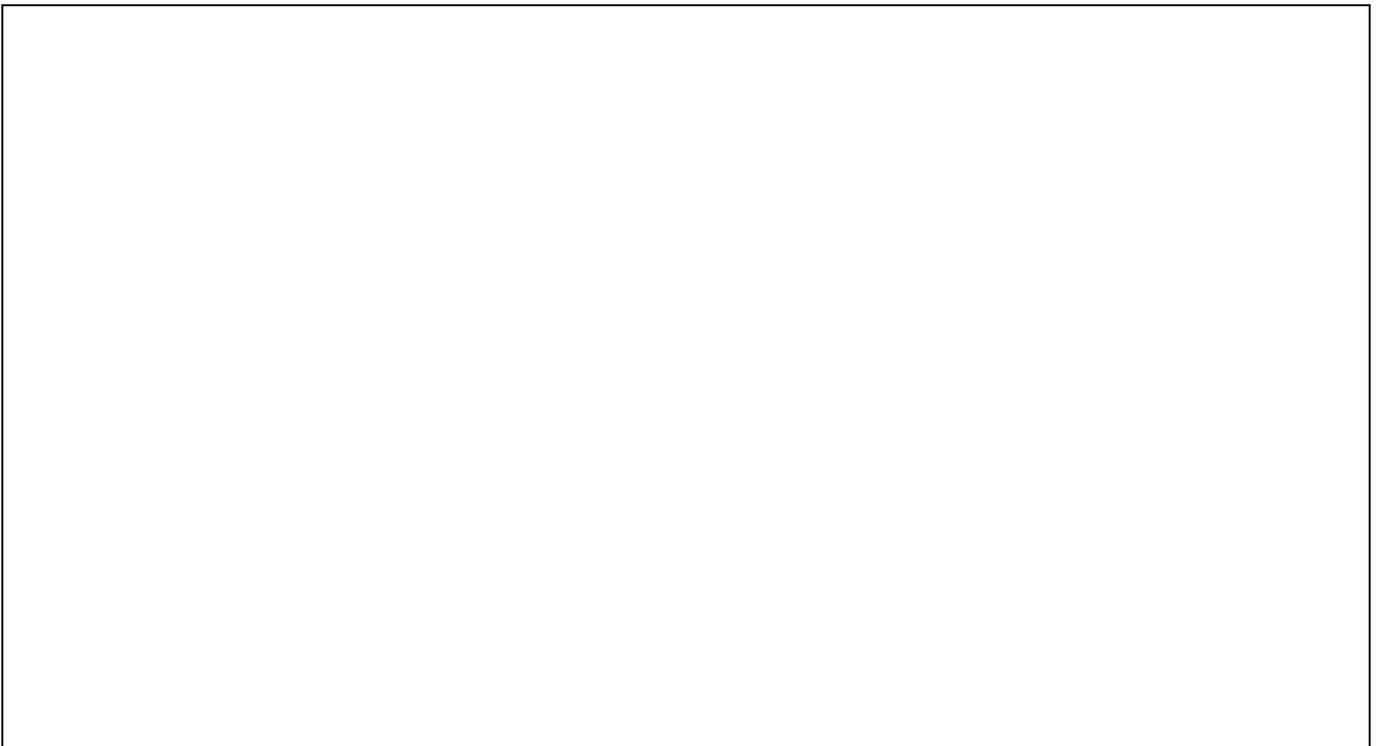
AUTHOR | SPEAKER | COACH

As featured in: TIME Forbes BBC SiriusXM

Previewing Exercise #3a: Think-Pair-Share – Tell your neighbor what it was all about . . .



Previewing Exercise #3b: Think-Pair-Share – Three Questions to Discuss



Individual Exercise #4a: “Count the Vowels”

Individual Exercise #4b: “Count the Vowels”

The “One-Minute” Paper:

A quick guide to assessing student learning after an educational experience

(Sinclair M, Rowe K, Brown G: NT Learn Curve 1998 2:4-5 – modified by LLo Jan. 2017*)



Name (please print): _____

Date of Education Experience: _____

Title / Name of Education Experience: _____

Directions: Take a moment to think about the educational experience you just completed and then answer the following three questions.

1. What was the **most important thing** you learned from this educational experience?

2. What **question remains** the uppermost in your mind at the end of this educational experience?

3. What was the **“muddiest (i.e. unclear) point”** from this educational experience?

*Selected Key References:

- (1) Stead DR: **A review of the one-minute paper**. Active Learning in Higher Education Aug 2015; 6(2):118-131.
- (2) Colbert CY, et al.: **Teaching Metacognitive skills: Helping your physicians in trainees in the quest to “Know what they don’t know.”** Am J Med March 2015; 128(3):318-324.

Metacognitive Learning Strategies

Evidence-based Education & the Science of Learning: Key Summary

(Revised January 30, 2018 – Lawrence Loo, MD)

*"Evidence-based Education" bridges the gap between the practice of learning in real world situations and research from the medical education literature, general education, neurosciences and cognitive psychology.

Adv Health Sci Educ Theory Pract 2012;17(2):225-240

- 1) No particular learning "style" is more effective than another. Most medical learners use more than one learning approach (i.e., there is no "holy grail" of study methods where one is clearly better).

- 2) Proven methods of *long term* (i.e. months to years) memory retention:
 - a) Practice **Testing Effect** (or Test-enhanced Learning): When studying material previously learned, repeated testing of information produces superior retention relative to repeated studying.
 - i) **Effort retrieval**: When testing, recall questions (e.g. short answers, fill in responses) promote better retention than recognition tests (e.g. multiple choice questions [MCQ]).
 - ii) One can turn a MCQ into a short answer question by covering up the answer options and asking oneself what the correct answer would be.
 - iii) Multiple methods of "testing" including writing down everything one thinks they know about a topic; flash cards (but you must write your own flash cards, not use others); verbal questioning from a colleague, small group discussions, etc.
 - b) **Spacing Effect (or Distributed Practice)**: Intermittent testing or studying distributed over time confers better memory retention than mass-practicing at a single point in time (i.e. it's better to study repeatedly over time than trying to "cram" everything in a single session).
 - i) The optimal number of times to retest and space in between varies with the goal of long term memory retention. The longer one wants to remember, the greater the frequency of retesting and the interval in between.
 - ii) For example in a 10 week cycle of major retesting, one may ideally want to test oneself three times: immediately after studying the material, one week later and 2-3 weeks later.
 - c) **Interleaving Effect**: Is it better to study in blocks (i.e. one subject at a time until "mastery") or mix subject topics while studying (i.e. interleaving)? Surprisingly, mixing subject topics reinforces long term memory better.
 - d) Why learners don't use the above 3 methods? Unfamiliar and takes more effort. *In short term testing, often results in poorer performance; but long term testing, memory retention is clearly better.*
 - e) **Elaborate Interrogation, Self-Explanation & Generation**: Learners generate explanations for an explicitly stated fact or concept or explaining how new information is related to known information or explaining the steps taken during problem solving. Examples: think-pair-share, discussions, organizing maps & tables, etc.
 - i) underlying theory: facilitates organization and discrimination (similarities & differences)
 - ii) possible use as a form of testing effect and spaced effect to quiz oneself

Evidence-based Education & the Science of Learning: Key Summary

“Don’t bother to take notes. Half of what you are taught as medical students will in five years have been shown to be either wrong or out of date. The trouble is, none of your teachers know which half. *So the most important thing to learn is ‘how to learn on our own.’*” From the opening address to the entering class of medical students by the Dean at the Harvard Medical School. *BMJ* 1956;2:113-6)

- 3) **“Retroactive Inhibition”**: Studying material in a highly emotional state (e.g. cramming the night before a national exam) may displace long term memories (i.e. learners might remember the material studied most recently but will often forget key information studied in the past). *Always get a good night’s rest before a major exam.* Remember the brain is working to consolidate and store information while sleeping.
- 4) **Less Effective Techniques** for Improving Learning: Possibly helpful to *some* students under *some* circumstances but the following cannot be recommended as a general evidence-based learning strategy for everyone.
 - a) **Rereading**: Overall utility ranking is “low.” Comparative studies to distributed practice, elaborative interrogation and self-explanation (see first page), rereading has been shown to be a “consistently inferior” technique for learning
 - spaced rereading (i.e. rereading a second time several days, weeks or even months later) is superior to rereading immediately after the first time
 - b) **Highlighting/Underlining**: Overall utility ranking “low.” The greatest problem is the variability in how learners use this technique. For some learners, training is required to optimize learning.
 - i) Marking too much text reduces its utility as a learning technique.
 - ii) Several authors suggest that one impose explicit limits on the amount of highlighting (e.g. a single sentence per paragraph).
 - c) **Summarization**: Overall utility ranking is “moderate.” Main problem is again students may not know how to summarize (i.e. identify the main points while excluding unimportant material). Students may need considerable training before ensuring this technique optimizes learning.
 - i) Higher-quality summaries that contained more information and that were linked to prior knowledge were associated with better performance. For students who already know how and effectively use summaries, probably can continue. A trickier issue is whether to use this strategy with those who are less skilled at creating summaries.
 - ii) In comparative studies a “middle of the pack” technique. More useful than rereading, as useful as note-taking, but less powerful than elaborative interrogation and self-explanation.
 - d) **Key word Mnemonic and Imagery Use**: Overall utility is “moderate.” May be very context specific (mnemonics for vocabulary words, lists of names and for imagery-friendly materials)
 - i) learners need to be trained; instructors may have to supply the mnemonics and images to be optimally used
 - ii) studies examining the durability of learning and variety of learning outcomes are preliminary

Recommended Resources:

- (1) Pahler H, et al.: *Organizing Instruction & Study to Improve Student Learning* (NCER 2007-2004). Washington, DC: National Center for Education Research, Institute of Education Sciences, U.S. Dept. of Education. 2007. <http://ncer.ed.gov>
- (2) Dunlosky J, Rawson KA, et al.: Improving students’ learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science* 2013; 14(1):4-58.
- (3) Fiorella L, Mayer RE: Eight ways to promote generative learning. *Educ Psychol Rev* 2016; 28:717-741.

**The Science (and Illusions) of Learning:
Curricular Implications for Medical Student and Residency Teaching & Learning***
(Lawrence Loo, MD - Revised August 7, 2017)

Test your own knowledge of the science of learning and long-term memory retention.	Science (Fact)	Illusion (Fallacy)
1) What is your reaction to seeing the results of your first medical school exam results (putting you at the 17 th percentile)?	a. OMG – I’m not smart enough !?! b. OMG – College didn’t prepare me well enough !?! c. OMG – I’ll have to work harder !?! d. OMG, I’ll have to try something different !?!	
2) Certain learning styles (e.g. visual, auditory, kinesthetic, etc.) have been demonstrated to correlate with better academic performance.		
3) Long-term learning is improved when the teacher <u>matches</u> the student’s particular learning style.		
4) Today’s millennial learners can multi-task better than their parents’ generation.		
5) Which of the following study “methods” is the <u>least</u> effective for long-term memory retention and recall.	a. Reading (and re-reading) b. Underlining and highlighting	
6) Which of the following study “methods” is the <u>most</u> effective for long-term memory retention and recall.	c. Word or picture mnemonics d. Sleeping	
7) Did you use “ Previewing ” as a regular study strategy during college?	(Yes)	(No)
8) When using practice test questions , long-term memory retention is better with a “ recognition ” approach or a “ recall ” approach?	(Recall)	(Recognition)
9) When preparing for exams , is it better to do practice test questions periodically (e.g. every 1-2 weeks) or just before the major exam (i.e. as one major review)?	(Periodically)	(1 Main Review)
10) If you had 3 days & 6 hours/day left to study for 3 major subjects, is it better to study 6 hours on one subject each day OR two hours a day on 3 different subjects?	(3 subjects/day)	(1 subject/day)

*(1) Brown PC, Roediger III HL, McDaniel MA: *Make It Stick : the Science of Successful Learning*. Cambridge, Massachusetts: The Belknap Press of Harvard University Press, 2014.
 (2) Dembo MH, Seli H: *Motivation and Learning Strategies for College Success. A Focus on Self-Regulated Learning*. 5th Edition. Taylor & Francis. 2016.