Developing a Case-Based Learning Module on the Science of Learning

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Site: Halifax, NS

Project Type:
Medical Education Tool (2021-2022 Resident Project Guide)

Introduction and Background

- There are effective and ineffective approaches to learning
- Appropriate education on evidence-based learning strategies is lacking in medical education
- Students come to medical school with varying backgrounds and study habits
    - Many habits are inefficient and would not be considered optimal for long-term retention
- Learning medicine requires long term-retention, i.e. “durable” learning

Introduction and Background

- Learners will receive advice from preceptors, libraries, articles, blogs, and videos.
- Quality of existing advice from these can be low, and difficult for learners to distinguish good from bad
- Fortunately, well-established evidence from cognitive psychology can guide learners of evidence-based approach to learning.
- These techniques are not widely used
- Goal: to develop medical education tool on the science of learning tutorial targeted at early undergraduate medical students

Why is this important?

- Family medicine requires expertise in very broad scope of knowledge and skills, and duty to teach these skills in effective ways
- Family medicine profession emphasized “clinical excellence,” “continuous learning and teaching of others,” and “commitment to reflective practice.”
- Becoming competent and excellent in a generalist profession is made much easier and efficient by a solid understanding of effective learning
- Family doctors should also be able to educate learners on how to effectively learn such breadth

Methods

Two components

1. Reviewing, assessing, and collecting relevant literature

2. Reviewing local undergraduate medical curriculum to decide where this material would fit.

Literature review

- Huge volume of published work on the science of learning
- Literature was assessed for common themes, and review resources were used where available.
- Common themes identified in the literature:
  - Humans are poor judges of when learning is effective
  - Ineffective learning strategies continue to be used heavily
  - Effective learning strategies exist and should be implemented
  - Catering to specific learning styles does not improve learning

The Science of Learning

- Learning – taking information into long-term memory for later retrieval.
- Three steps
    1. Encoding – bringing information into short term memory
    2. Consolidation – strengthening, stabilizing, and organizing into long term memory (sleep is important here)
    3. Retrieval – accessing learned information, further strengthening memory.
- Retrieval is most important for most learning, i.e. we study so that we can call up information when it is needed.

We are poor judges of our learning

- We can’t rely on our own judgement of when learning is effective or not. Many studies demonstrate this, several factors at play
- *Fluency illusions*: we mistake fluency with a text for mastery of its content
- *Ease of practice*: learning feels more effective when it is easy, but durable learning requires *desirable difficulty*.
- *Quick gains*: learning feels effective when gains are quick, common with *massed practice*, but quick gains also fade quickly.

Ineffective learning strategies persist

- Most common ineffective learning strategies
  - Cramming
  - Massed practice
  - Highlighting
- Their use persists
  - Can be effective for passing tests
  - They make us feel that real learning is happening, but the learning is not durable
- These do not work for preparing for clinical duties, as we need to be ready for many different scenarios at unpredictable times

Effective learning strategies exist

- ***Retrieval-based learning*** – "retrieval interrupts forgetting." Also acts as objective measure to identify knowledge gaps.
  - *Testing effect* – testing enhances later retention more than additional study of the material
- ***Spaced repetition*** – periodically returning to the material
- ***Interleaving*** – varying topics/skills studied in a single session, i.e. not waiting until "done" before moving on
- ***Elaboration*** – "Learning is stronger when it matters, when the abstract is made concrete and personal."
- ***Metacognition*** – Knowing about what you know

The “Learning Styles” Myth

- The claim: learning is more effective when content is delivered in a manner consistent with the preferred learning style of the learner.
- The reality
  - Thoroughly studied
  - No good evidence to support
  - There are *many* learning style frameworks, how would we know which is best?
  - Learning more effective when modality is suited to the content, rather than suited to the learner.

Professional Competency Curriculum

- Identified as appropriate target for this material
  - “Pro Comp” is meant to provide "opportunity to integrate your biomedical and clinical learning within the context of patient care from a professional, community and life-long learner perspective,”
- Consists of weekly one-hour large group session, followed by 2 hour small group tutorial sessions.
- Students are expected to have reviewed tutorial material, done assigned pre-reading, and answer questions
- Past curriculum reviewed for template, and to ensure no similar material already exists.

The Medical Education Tool

- Developed a 32-minute didactic session, pre-recorded for purposes of this project.
- Developed small group case of struggling learners to explore the common experiences and strategies to overcome.
- Objectives created for these sessions.
- All material was generated to be consistent in format, language, and style of other Pro Comp sessions

Objectives for sessions

- By the end of this lecture, you will be able to
  - Define and describe well-established evidence-based learning strategies: Retrieval-based learning, Spaced repetition, Interleaving, Frequent testing, Elaborative interrogation and self-explanation, Metacognition
  - Describe the pitfalls with commonly used study techniques: massed practice, reading as a form of studying, highlighting, cramming
  - Understand and discuss the limitations of using learner subjective judgement to assess quality of learning activity.

- By the end of this tutorial, you will be able to:
  - Apply the concepts discussed in the lecture to assess and critique quality of current learning strategies through cases and self-analysis.
  - Develop and make plans to implement evidenced-based learning strategies.
  - Use your knowledge of evidence-based learning strategies to analyze system-level learning and where there is room for improvement.

Future work

- Discussion with the undergraduate medical education office about implementation
- Development of longitudinal theme of this topic
- Assessment of currently used learning strategies locally
- Discussion with Student/Resident Affairs office about whether resources are consistent with evidence-based learning strategies.
- Development of CPD material for residents and practicing clinicians.

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Selected references (more in report)

- Brown PC, Roedinger HL, McDaniel MA. Make It Stick: The Science of Successful Learning. The Belknap Press of Harvard University Press; 2014.
- Van Hoof TJ, Doyle TJ. Learning science as a potential new source of understanding and improvement for continuing education and continuing professional development. Med Teach. 2018;40(9):880-885. doi:10.1080/0142159X.2018.1425546
- Piza F, Kesselheim JC, Perzhinsky J, et al. Awareness and usage of evidence-based learning strategies among health professions students and faculty. Med Teach. 2019;41(12):1411- 1418. doi:10.1080/0142159X.2019.1645950
- Bjork EL, Bjork RA. Making things hard on yourself, but in a good way: Creating desirable difficulties to enhance learning. In: Psychology and the Real World: Essays Illustrating Fundamental Contributions to Society. Worth Publishers; 2011:56-64.
- Moulton CAE, Dubrowski A, MacRae H, Graham B, Grober E, Reznick R. Teaching Surgical Skills: What Kind of Practice Makes Perfect? Ann Surg. 2006;244(3):400-409. doi:10.1097/01.sla.0000234808.85789.6a
- Raupach T, Andresen JC, Meyer K, et al. Test-enhanced learning of clinical reasoning: a crossover randomised trial. Med Educ. 2016;50(7):711-720. doi:10.1111/medu.13069
- Jape D, Zhou J, Bullock S. A spaced-repetition approach to enhance medical student learning and engagement in medical pharmacology. BMC Med Educ. 2022;22(1):337. doi:10.1186/s12909-022-03324-8
- Lambers A, Talia AJ. Spaced Repetition Learning as a Tool for Orthopedic Surgical Education: A Prospective Cohort Study on a Training Examination. J Surg Educ. 2021;78(1):134-139. doi:10.1016/j.jsurg.2020.07.002