

# UCSF

## UC San Francisco Previously Published Works

### Title

The Learning Sciences Meet the Learning Health System

### Permalink

<https://escholarship.org/uc/item/5g26101c>

### Journal

JAMA Network Open, 5(7)

### ISSN

2574-3805

### Authors

Wlodarczyk, Susan

Dhaliwal, Gurpreet

### Publication Date

2022-07-01

### DOI

10.1001/jamanetworkopen.2022.23113

### Copyright Information

This work is made available under the terms of a Creative Commons Attribution-NonCommercial-NoDerivatives License, available at

<https://creativecommons.org/licenses/by-nc-nd/4.0/>

Peer reviewed



# The Learning Sciences Meet the Learning Health System

Susan Wlodarczyk, MD; Gurpreet Dhaliwal, MD

Lifelong learning is central to the identity of a physician. Yet rarely in medical education do we emphasize how to learn. Instead, we generally work under the assumption that physicians, who were proficient enough to succeed in their premedical years, are optimally skilled at learning during medical school, postgraduate training, and throughout their careers. This assumption goes untested, but when the desired outcome of education initiatives is enacting evidence-based practices, it is crucial that health systems use methods of learning that are the most effective, efficient, and durable.

McEvoy et al<sup>1</sup> report the results of a single-center randomized cluster crossover trial using spaced education and retrieval practice with feedback to disseminate knowledge to clinicians at scale and measure the effect on prescribing patterns. After completing an app-based educational module with daily multiple-choice quiz questions over 4 weeks, clinicians were more likely to follow the evidence-based practice of prescribing balanced crystalloids rather than normal saline. This approach exemplifies how learning health systems can use evidence-based learning to improve clinical practice.

## + Related article

Author affiliations and article information are listed at the end of this article.

## The Science of Learning

The learning sciences is a multidisciplinary field that examines which methods of instruction and study best promote understanding. The learning sciences field has empirically proven that certain strategies yield deeper and more durable learning,<sup>2</sup> yet these methods remain underused by medical students and physicians.<sup>3</sup>

McEvoy et al<sup>1</sup> used 2 strategies that have the most evidence for enhancing learning: spaced education and retrieval practice. Retrieval practice is recalling information from memory (eg, quizzing through multiple-choice questions or flashcards) instead of rereading or rehearing content. Spaced education is scheduling small doses of information over intervals rather than learning all material in a single contiguous block. The learning sciences have demonstrated the efficacy of several other techniques including interleaving (deliberately alternating between topics when studying) and elaboration (making explanations and connections among concepts).

Evidence-based learning strategies require more effort and advance planning than familiar studying approaches. Massed learning (all content delivered at once, including cramming) feels coherent and satisfying in the short term, while the forgetting that sets in later goes unnoticed. Conversely, spaced education deliberately reveals forgotten information since the last exposure but reinforces content over time. Rereading material fosters a sense of familiarity that is easily equated with understanding, while quizzing with multiple choice questions can be discouraging because it starkly reveals forgetting that has transpired. Listening to a lecture or podcast feels enlightening in the moment, whereas grappling with the material by teaching it to someone else usually reveals gaps in our understanding. The learning sciences methods highlight forgetting, which makes them nonintuitive and uncomfortable, but they also motivate and solidify learning.

**Open Access.** This is an open access article distributed under the terms of the CC-BY License.

## Rethinking Our Approach to Learning

One path to enhancing clinician familiarity with learning science approaches is to embed these methods in curricula and instruction throughout the medical education continuum. At the University of California San Francisco School of Medicine, we teach students learning sciences concepts early in the first year and present concrete examples of integrating quizzing and spaced education (eg, digital flashcards) drawn from the curriculum.<sup>4</sup> The learning sciences have also informed training programs outside of traditional curricular structures. The American Heart Association replaced its multiyear cardiopulmonary resuscitation recertification approach with the Resuscitation Quality Improvement Program, in which clinicians undergo quarterly training that emphasizes quizzing and simulation practice with feedback.<sup>5</sup>

Residency and fellowship curriculum leaders can similarly reimagine how knowledge and skills are fostered.<sup>6</sup> Instead of isolated lectures and videos, programs could standardize the practice of subscribing learners to app-based quiz questions to engage in spaced retrieval practice after the session. Instead of structuring content by discipline or organ system, programs could interleave topics across a longitudinal curriculum. In preparation for an inservice or licensing examination, trainees could submit a study strategy for feedback from a faculty coach to optimize their approach.

---

## Much to Learn

The education science literature offers decades of research on proven techniques about how people learn best.<sup>2</sup> These core principles, originally tested in classrooms, have been verified in studies of medical students and have been applied to graduate medical education and continuing professional development settings to change clinical practice.<sup>7</sup> A study of urology residents randomized to spaced education with daily educational emails demonstrated better knowledge retention compared with a bolus education group that received 1 communication with the same study questions.<sup>8</sup> In another study,<sup>9</sup> neurologists who engaged in retrieval practice with repeated short-answer quizzes after attending a continuing medical education lecture demonstrated better knowledge retention at 6 months compared with attendees who engaged in repeated studying of the material alone.

The study by McEvoy et al<sup>1</sup> is another application of learning sciences principles in the clinical setting. Although the intervention changed clinician behavior, the effect did not persist beyond 4 weeks. Questions remain about how to best operationalize the learning sciences to achieve sustained practice change. What is the optimal interval to space content if the goal is long-term retention over years? What is the best format for retrieval practice: selecting answers from multiple-choice options or generating a short answer from memory? More field testing is needed to understand how learning sciences principles can hardwire new knowledge and behaviors in the clinical environment.<sup>7</sup>

---

## Catalyzing Change

Changing clinician behavior is the final step in bridging the evidence-to-practice gap in medicine. It is a complex process mediated by colleagues, incentives, feedback, removal of barriers, unlearning, and learning. Behavioral economics and sociology are as important as cognitive neuroscience in effecting this change.

For the component of behavior change that depends on learning, McEvoy et al<sup>1</sup> provide a practical example of how to use spaced education and retrieval practice at scale to effect evidence-based practice and reimagine our approach to learning in the clinical setting. A strong foundation that starts early in medical training and informs all instructional efforts will help us see how the learning health system and the learning sciences go hand in hand.

**ARTICLE INFORMATION****Published:** July 26, 2022. doi:[10.1001/jamanetworkopen.2022.23113](https://doi.org/10.1001/jamanetworkopen.2022.23113)**Open Access:** This is an open access article distributed under the terms of the [CC-BY License](https://creativecommons.org/licenses/by/4.0/). © 2022 Wlodarczyk S et al. *JAMA Network Open*.**Corresponding Author:** Susan Wlodarczyk, MD, San Francisco VA Medical Center, 4150 Clement St (111), San Francisco, California 94121 ([susan.wlodarczyk@ucsf.edu](mailto:susan.wlodarczyk@ucsf.edu)).**Author Affiliations:** Medical Service, San Francisco Veterans Affairs Medical Center, San Francisco, California (Wlodarczyk, Dhaliwal); Department of Medicine, University of California San Francisco (Wlodarczyk, Dhaliwal).**Conflict of Interest Disclosures:** None reported.**REFERENCES**

1. McEvoy MD, Dear ML, Buie R, et al; Vanderbilt Learning Healthcare System Platform Investigators and Vanderbilt Committee on Opioid Monitoring and Stewardship. Effect of smartphone app-based education on clinician prescribing habits in a learning health care system: a randomized cluster crossover trial. *JAMA Netw Open*. 2022;5(7):e2223099. doi:[10.1001/jamanetworkopen.2022.23099](https://doi.org/10.1001/jamanetworkopen.2022.23099)
2. Gooding HC, Mann K, Armstrong E. Twelve tips for applying the science of learning to health professions education. *Med Teach*. 2017;39(1):26-31. doi:[10.1080/0142159X.2016.1231913](https://doi.org/10.1080/0142159X.2016.1231913)
3. 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](https://doi.org/10.1080/0142159X.2019.1645950)
4. Ransohoff A, Boscardin C, Hauer KE, Wlodarczyk S. Rethinking how to introduce the learning sciences: a near-peer approach. *Med Sci Educ*. 2020;31(1):45-47. doi:[10.1007/s40670-020-01142-5](https://doi.org/10.1007/s40670-020-01142-5)
5. American Heart Association. Resuscitation quality improvement annotated bibliography. July 7, 2017. Accessed May 25, 2022. [https://cpr.heart.org/-/media/CPR-Files/Courses-and-Kits/RQI/RQI-Annotated-Bibliography-ucm\\_496707.pdf](https://cpr.heart.org/-/media/CPR-Files/Courses-and-Kits/RQI/RQI-Annotated-Bibliography-ucm_496707.pdf)
6. Krimmel-Morrison JD, Dhaliwal G. How to keep training-after residency training. *J Gen Intern Med*. 2022;37(6):1524-1528. doi:[10.1007/s11606-021-07240-3](https://doi.org/10.1007/s11606-021-07240-3)
7. Versteeg M, Hendriks RA, Thomas A, Ommering BWC, Steendijk P. Conceptualising spaced learning in health professions education: a scoping review. *Med Educ*. 2020;54(3):205-216. doi:[10.1111/medu.14025](https://doi.org/10.1111/medu.14025)
8. Kerfoot BP, Baker HE, Koch MO, Connelly D, Joseph DB, Ritchey ML. Randomized, controlled trial of spaced education to urology residents in the United States and Canada. *J Urol*. 2007;177(4):1481-1487. doi:[10.1016/j.juro.2006.11.074](https://doi.org/10.1016/j.juro.2006.11.074)
9. Larsen DP, Butler AC, Aung WY, Corboy JR, Friedman DI, Sperling MR. The effects of test-enhanced learning on long-term retention in AAN annual meeting courses. *Neurology*. 2015;84(7):748-754. doi:[10.1212/WNL.0000000000001264](https://doi.org/10.1212/WNL.0000000000001264)