



Alliance for Academic Internal Medicine

Association of Professors of Medicine
 Association of Program Directors in Internal Medicine
 Association of Specialty Professors
 Clerkship Directors in Internal Medicine
 Administrators of Internal Medicine

AAIM Perspectives

AAIM is the largest academically focused specialty organization representing departments of internal medicine at medical schools and teaching hospitals in the United States and Canada. As a consortium of five organizations, AAIM represents department chairs and chiefs; clerkship, residency, and fellowship program directors; division chiefs; and academic and business administrators as well as other faculty and staff in departments of internal medicine and their divisions.

Lectures for Adult Learners: Breaking Old Habits in Graduate Medical Education



Avraham Z. Cooper, MD,^a Jeremy B. Richards, MD, MA^b

^aDivision of Pulmonary, Critical Care, and Sleep Medicine, The Ohio State University, Columbus; ^bDivision of Pulmonary, Critical Care, and Sleep Medicine, and Internal Medicine Clerkship, Medical University of South Carolina, Charleston.

Lectures have been the primary method of conveying information to groups of learners since at least the Middle Ages.¹ Prior to the advent of the printing press, lecturing was the most efficient way to provide formal instruction. Although many aspects of lecturing have changed over the past several centuries, this format of instruction has so far withstood the test of time.² Modern critiques of lecturing as pedagogy date back to 1931, when Hamilton Holt described the lecture as “that mysterious process by means of which the contents of the professor’s notebooks are transferred by means of the fountain pen to the pages of the student’s notebooks without passing through the minds of either.”³ Despite criticism of traditional reliance on lectures and the call for alternative pedagogic strategies (such as electronic resources and flipped classroom models),⁴⁻⁷ lecturing remains well established in medical education, both in teaching medical students in classroom settings and in teaching students, residents, and fellows on clinical rotations.

Educators in graduate medical education (GME) rely on lectures in a variety of settings, including pre- or postclinic teaching sessions and morning and noontime teaching conferences for fellows and residents,⁸ and will continue to for the foreseeable future. How can lectures be made more effective for learners? Adult learner retention rates after traditional lectures have been estimated at a dismal 5%.⁹ Based on adult learning theory and relevant cognitive psychological perspectives, we argue that to match the needs and limitations of housestaff and fellows, GME lectures must be more focused, active, and shorter in duration.¹⁰ Educators and curriculum developers should take into account how the principles of adult learning theory apply to their learners specifically. Although we utilize specific, actionable examples from the perspective of the internal medicine residency, these principles are applicable to lecturing to GME learners in general.

COGNITIVE PSYCHOLOGY: WORKING MEMORY AND INTERFERENCE

Current morning or noontime lectures last typically around an hour. However, adult learning data suggest that typical learner attention span wanes after about 15 to 20 minutes.¹¹ After 20 minutes, lectures become less effective for 2 reasons: working memory and interference.

As learners encounter unfamiliar information or are exposed to new concepts for the first time, they use working memory to process that input, integrating new

Funding: None.

Conflict of Interest: There exist no financial or other conflicts of interest that may affect the information, analysis, or interpretation presented in the manuscript.

Authorship: Both authors participated in conceptualizing, writing, reviewing, and finalizing the manuscript and are qualified to be authors.

Requests for reprints should be addressed to Avraham Z. Cooper, MD, 201 Davis Heart and Lung Research Institute, 473 West 12th Avenue, Columbus, OH 43210.

E-mail address: avrahamcooper@gmail.com

data with existing knowledge to form long-term memories.¹² This process requires active attention and the ability to focus on and dynamically manipulate novel and unfamiliar information and concepts. As a lecture progresses, learners receive more information that requires additional manipulation by working memory, impeding the assimilation of information still being processed from prior parts of the lecture. This decrease in the capacity to effectively incorporate new information in a meaningful and efficient manner is a process called interference.¹² Interference makes longer lectures both less enjoyable and less effective, and is a major cognitive impediment to knowledge acquisition for all learners, including GME learners.

ADULT LEARNING THEORY

Working memory and interference are inevitably influenced by learner engagement, and motivation to listen to and work with new or unfamiliar material, as well as awareness of how learner motivation and engagement influences knowledge acquisition, is important. Adult learning theory, or andragogy, describes a theoretical framework that encompasses these concepts.¹³

While a comprehensive consideration of adult learning theory and its relationship to cognitive psychology is beyond the scope of this article, andragogy has been recently addressed more fully elsewhere.¹⁴ This article focuses on how understanding and applying adult learning theory can improve lectures in GME.

The foundational principles of adult learning theory emphasize the importance of applicability of content to a learner's individual goals and objectives and describe the importance of autonomy in growth and learning. These principles are highlighted by six cardinal learner-related factors: the need to know, the learner's self-concept, the role of learner's experiences, readiness to learn, orientation to learning, and motivation.

NEED TO KNOW

Adult learners more readily engage with material when they can identify relevance to their own goals and objectives. As described by Taylor and Hossam,¹⁴ the need to know begins when a learner's existing knowledge is demonstrated (and understood by the learner) to be incomplete, also known as learner dissonance.

Dissonance is achieved through both the educator and learner identifying knowledge deficits that are relevant to the learner's goals, interests, and objectives. Educators can leverage this principle by carefully identifying core topics and concepts that are important to their learners and enhance learning by providing context, resources, and extrinsic motivations to learners during teaching sessions.

In a general medicine clinic, for example, while a thorough discussion of the care of patients who have received a liver transplant may address a knowledge deficit for residents, the immediate relevance of this topic will be marginal. As such, while dissonance may be transiently achieved, the duration and relevance of a resident's dissonance is limited. Identifying topics that are more directly relevant to the work of residents and fellows in clinic enhances engagement and provides opportunities for solidifying concepts discussed in the

lecture. When learners see patients in clinic with the conditions or problems discussed during the teaching session, the dissonance created from the learner's knowledge deficits and the need to engage and grapple with the encountered concepts results in more meaningful learning.

LEARNER'S SELF-CONCEPT

Adult learners, especially in residency or fellowship, often have competing influences on their time and mental energy. A busy on-call ward resident at a noontime conference, for example, has numerous other obligations besides assimilating the topic being presented. Learners have an intrinsic self-concept of what their goals and objectives are for any given learning experience (eg, addressing self-recognized knowledge gaps, enhanced conceptual understanding of a difficult topic), and their prioritization of that experience will be determined by how well the material aligns with those goals. If a lecture topic is not compatible with their self-concept, residents and fellows are less likely to prioritize that lecture and therefore less likely to pay attention or put in the cognitive work of deeply considering the content being presented.

ROLE OF LEARNERS' EXPERIENCES

GME learners come to a lecture with a preexisting fund of knowledge about a given topic based on past

PERSPECTIVES VIEWPOINTS

- The traditional lecture format results in low learner retention rates and engagement.
- To be maximally effective, lectures for graduate medical education (GME) learners should incorporate the principles of adult learning theory, cognitive psychology, and active learner participation.
- Shorter lecture duration respects GME learners' limitations and attention spans, and helps medical educators focus on delivering the highest-yield content.

educational and clinical experience. They also have knowledge deficits. Educators demonstrate respect for learners when they ask residents and fellows what they know about a topic in advance, which allows for adapting the content of the lecture to address knowledge deficits in light of learners' prior experiences. For instance, prior to lecturing to a group of residents on advances in the management of congestive heart failure, sending them an e-mail that requests their input on topics that have not yet been covered, or are of particular interest in their curriculum, allows for tailoring the lecture content to the educational needs and desires of that group of learners.

READINESS TO LEARN

Depending on where they are in training, learners at different stages will have different levels of readiness to encounter more or less nuanced or advanced material. Early interns may not have the clinical or knowledge background to benefit from a lecture on interventional coronary angiographic techniques, but would benefit from foundational topics such as diagnosis of acute myocardial infarction. First year Cardiology fellows, on the other hand, are ready and need to learn about coronary angiography.

ORIENTATION TO LEARNING

For adult learners to engage with encountered material, they must feel that the material is applicable and relevant to their immediate situation. Learners are more likely to engage with a lecture on the management of respiratory failure if it is given while they are rotating in the intensive care unit vs when they are rotating on a specialty consult elective.

MOTIVATION TO LEARN

Awareness of the internal motivations that drive learner behavior can help maximize attention and interest in a topic. Senior residents studying for board examinations are motivated by a desire to learn high-yield concepts relevant to the upcoming examination and will likely engage with a lecture that acknowledges and addresses that motivation; new interns, who want and need to learn the basics of inpatient medical management, are more likely to connect with a lecture that helps them achieve this goal.

BRINGING THEORY TO PRACTICE

Bridging the gap between the principles of adult learning theory and cognitive psychology and day-to-day educational practice remains a challenge. Adult learning theory provides a framework for curricular planning and content inclusion, but making lectures for GME more effective also requires implementable, practical, point-of-learning

strategies. We suggest that the combination of rational lecture organization, ensuring active learner participation, and shorter teaching session durations offers an approach to achieve this goal.

RATIONAL ORGANIZATION

Rational approaches to lecture organization can directly address the issues of limited working memory and interference in GME learners. Taking into account how learners learn and using that information to organize lectures in a deliberate manner that aligns with the principles of adult learning theory and cognitive psychology will allow for a more effective educational experience. Similarly, identifying how learners are motivated to understand their current knowledge about a problem or concept is critical to rational lecture design; it promotes dissonance and internally motivated engagement. Acknowledging how learners assimilate and use new information can also inform rational design of lectures; framing problems or concepts in a manner that orients learners toward application of knowledge will increase immediate relevancy.¹⁴ The "how" and "why" of adult learning is as important as the "what."

ACTIVE LEARNER PARTICIPATION

Identifying opportunities for engagement and interactivity during lectures enhances content retention and relevancy. The evidence for active learning is compelling; numerous positive studies involving learners of different levels in many different contexts have demonstrated the effectiveness of active learning vs passive lecturing.¹⁵⁻²³ As one example of the impact of active learning, a recent meta-analysis of 225 studies assessed outcomes of traditional lecturing vs active learning techniques in undergraduate students in science, technology, engineering, and mathematics courses.²⁰ Student performance on examinations significantly improved in classes incorporating active learning, with an average increase in scores of approximately 6%. Traditional lectures were associated with a 1.5-fold increase in the risk of failing.

The results of this meta-analysis and other studies support the contention that application and interaction increase learner engagement and knowledge retention.¹⁶⁻²⁴ Offering adult learners the opportunity to apply knowledge provides them time to relate new or unfamiliar information to existing knowledge. We summarize several active teaching strategies that educators can use during lectures and teaching sessions in the [Table](#). [Figure](#) demonstrates how to structure a lecture around active learning strategies.

SHORTER DURATIONS

In keeping with the principles of cognitive psychology, shortening lecture duration can make them more

Table Active Learning Strategies for Use in Lectures, with Examples for Teaching GME Learners

Active Learning Strategy for Use in Lectures	Description	Example of Using This Strategy in GME Lectures
Peer Instruction ²⁴	Break lecture material into short segments interspersed with conceptual questions that learners answer first on their own, followed by discussion with 3-4 colleagues to develop a group consensus answer.	During a preclinic teaching session, identify 3-4 conceptual questions to ask learners about the material being discussed. Dedicate time for the learners to answer the questions on their own and then discuss with each other.
ACTIVE ¹⁶	Assemble learners into small groups, Convey 3-5 learning points, Teach a limited amount of content, Inquire about how the content applies to patient management, Explain answer choices.	Divide an intensive care unit team into small groups and break up the lecture into 5–7-minute blocks, with discussion questions for the small groups to work through.
Buzz Groups	Divide a large group of learners into pairs or small groups at the beginning of a lecture, who then collaboratively answer questions posed throughout.	On a specialty consult service, divide learners into pairs and pose discussion questions for them to actively discuss intermittently throughout the lecture.
Audience Response Systems	Assess individual responses to questions in real time using technologic (“clickers” or Web-based platforms) or manual responses (paper-based or show of fingers)	In a preclinic conference, supplement content with frequent multiple-choice questions about the topic being discussed. Learners answer via a Web-based poll platform.
Assign In-Class Writing	During or after a lecture, learners write a brief summary of what they learned during the lecture.	After a morning report session, ask learners to write a paragraph about the 3 most interesting things they learned during the lecture. Review their writings to assess the effectiveness of the lecture.
Think-Pair-Share	Divide learners into pairs, and ask them to think about questions posed during the lecture, discuss the questions in pairs , and then share their consensus answer with the group.	Divide interns and residents into pairs at the beginning of a wards rotation. Interject questions for them to consider using the Think-Pair-Share model during teaching sessions.

GME = graduate medical education.

effective. Consider an illustrative intensive care unit teaching session. Instead of a comprehensive, hour-long PowerPoint (Microsoft Corporation, Redmond, Wash.) lecture on the intricacies of the different modes of mechanical ventilation, a 15-minute primer on the fundamentals of mechanical ventilation followed by a 15-minute interactive teaching session and discussion at the bedside of a ventilated patient would likely yield higher learner satisfaction, more meaningful dissonance, conceptual understanding, and knowledge retention. The hour-long lecture may cover more content and residents are “exposed” to more information, but assuming that the learners meaningfully retained the topics discussed would be to fall victim to the “fallacy of knowing”: the assumption that if someone is exposed to a piece of information, then they must immediately learn it.²⁵

RETHINKING ASSUMPTIONS

Such a transition in format toward shorter, more interactive lectures will require a frameshift in how educators think about curricular development. This

shift would necessitate identification and inclusion of the highest-yield topics for any given group of learners, with judicious use of supplementary, preferably online, resources.²⁶ Faculty development should focus on incorporating proven active learning techniques into teaching sessions, and lectures that have been delivered without changes for years will need to be revised. Reading from a PowerPoint slide set to a group of learners should not be accepted as adequate teaching.

There are arguments against modifying lectures, and specifically, concerns about shortening the duration of lectures.^{27,28} One such argument against shortening GME lectures is the desire to expose residents and fellows to as much core content as possible, with the assumption that maximizing content delivery necessitates longer lectures. Curriculum developers have an understandable desire to “fit it all in.” Such an impulse, however, is ultimately counterproductive. Developing high-yield, effective sessions should be the priority, rather than focusing on exposing learners to large amounts of material.²⁹ Utilizing the principles of adult

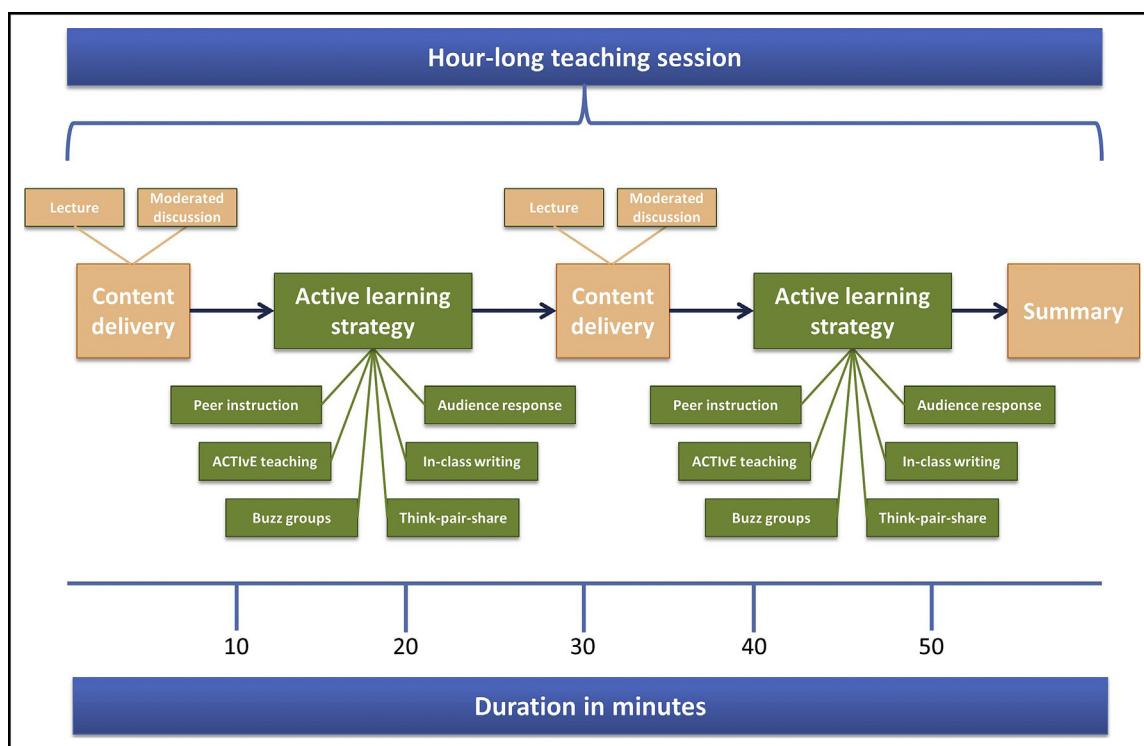


Figure This is a framework for how to structure an hour-long lecture, to maintain learner engagement and enhance efficacy, by using active learning strategies interspersed with content delivery.

learning theory and shorter, active construction can help educators develop and deliver more successful lectures.

CONCLUSION

As more becomes known about adult learning theory and practice as well as what constitutes optimal learning environments, we owe it to residents, fellows, and their patients to apply these principles to create more effective lectures for our learners. The principles of adult learning should inform rational lecture and curriculum design; the need for dissonance offers an important perspective on how residents learn and has applicability to lecture content and construction. Working memory and interference influence attention and engagement for all learners, but are particularly relevant for GME learners because they have extensive competing clinical obligations—making lectures shorter can increase efficacy. Breaking old habits is hard, but incorporating active learning and adult learning theory into GME lectures are critical steps for improving their educational value.

References

- Friesen N. The lecture as a transmedial pedagogical form: a historical analysis. *Educ Res.* 2011;40:95-102.
- Hurst JW. The overlecturing and underteaching of clinical medicine. *Arch Intern Med.* 2004;164:1605-1608.
- Honan WH. The college lecture, long derided, may be fading. *The New York Times.* August 14, 2002:B7.
- Prober CG, Heath C. Lecture halls without lectures — a proposal for medical education. *N Engl J Med.* 2012;366:1657-1659.
- Nickson CP, Cadogan MD. Free Open Access Medical education (FOAM) for the emergency physician. *Emerg Med Australas.* 2014;26:76-83.
- White G. Interactive lecturing. *Clin Teach.* 2011;8:230-235.
- Bligh D. *What's the Use of Lectures?* San Francisco: Jossey-Bass; 2000.
- Lenz PH, McCallister JW, Luks AM, et al. Practical strategies for effective lectures. *Ann Am Thorac Soc.* 2014;12:561-566.
- Masters K. Edgar Dale's pyramid of learning in medical education: a literature review. *Med Teach.* 2013;35:e1584-e1593.
- Sawatsky AP, Zickmund SL, Berlacher K, et al. Understanding resident learning preferences within an internal medicine noon conference lecture series: a qualitative study. *J Grad Med Educ.* 2014;6:32-38.
- Jeffries WB. Teaching large groups. In: Jeffries WB, Huggett KN, eds. *An Introduction to Medical Teaching.* Dordrecht, Netherlands: Springer Netherlands; 2014:11-26.
- Nelson C. What are the differences between long-term, short-term, and working memory? *Prog Brain Res.* 2008;169:323-338.
- Knowles M. *The Adult Learner: A Neglected Species.* Houston, TX: Gulf; 1988.
- Taylor DM, Hossam H. Adult learning theories: Implications for learning and teaching in medical education: AMEE Guide No. 82. *Med Teach.* 2013;35:e1561-e1572.
- Clardy PF, Schwartzstein RM. Considering cognition: current challenges and future directions in Pulmonary and Critical Care Fellowship training. *Ann Am Thorac Soc.* 2015;12:474-479.
- Sawatsky AP, Berlacher K, Graieri R. Using an ACTIVE teaching format versus a standard lecture format for increasing resident interaction and knowledge achievement during noon conference: a prospective, controlled study. *BMC Med Educ.* 2014;14:129.

17. Rao SP, DiCarlo SE. Active learning of respiratory physiology improves performance on respiratory physiology examinations. *Adv Physiol Educ.* 2001;25:127-133.
18. Krupat E, Richards JB, Sullivan AM, et al. Assessing the effectiveness of case-based collaborative learning via randomized controlled trial. *Acad Med.* 2016;91(5):723-729.
19. Freeman S, Eddy SL, McDonough M, et al. Active learning increases student performance in science, engineering, and mathematics. *Proc Natl Acad Sci U S A.* 2014;111:8410-8415.
20. Smith MK, Wood WB, Adams WK, et al. Why peer discussion improves student performance on in-class concept questions. *Science.* 2009;323:122-124.
21. Melo Prado H, Hannois Falbo G, Rodrigues Falbo A, Natal Figueiroa J. Active learning on the ward: Outcomes from a comparative trial with traditional methods. *Med Educ.* 2011;45:273-279.
22. Haidet P, Morgan RO, O'Malley K, et al. A controlled trial of active versus passive learning strategies in a large group setting. *Adv Health Sci Educ Theory Pract.* 2004;9:15-27.
23. Koles P, Nelson S, Stolfi A, et al. Active learning in a Year 2 pathology curriculum. *Med Educ.* 2005;39:797-806.
24. Crouch CH, Mazur E. Peer instruction: ten years of experience and results. *Am J Physiol.* 2001;69:970-977.
25. Jackson M. Catching our eye: the alluring fallacy of knowing at a glance. In: Bauerlein M, Bellow A, eds. *The State of the American Mind: 16 Leading Critics on the New Anti-intellectualism.* West Conshohocken, PA: Templeton; 2015:111-122.
26. Goh J, Clapham M. Attitude to e-learning among newly qualified doctors. *Clin Teach.* 2014;11:20-23.
27. Small A. In defense of the lecture. *Chron High Educ.* May 27, 2014.
28. Wilson K, Korn JH. Attention during lectures: beyond ten minutes. *Teach Psychol.* 2007;34:85-89.
29. Meyer JHF, Land R. Threshold concepts and troublesome knowledge: linkages to ways of thinking and practicing. In: Rust C, ed. *Improving Student Learning – Theory and Practice Ten Years On.* 2003. Oxford, UK: Oxford Centre for Staff and Learning Development; 2003.