

Teaching Radiology Trainees From the Perspective of a Millennial

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The millennial generation consists of today's medical students, radiology residents, fellows, and junior staff. Millennials' comfort with immersive technology, high expectations for success, and desire for constant feedback differentiate them from previous generations. Drawing from an author's experiences through radiology residency and fellowship as a millennial, from published literature, and from the mentorship of a long-time radiology educator, this article explores educational strategies that embrace these characteristics to engage today's youngest generation both in and out of the reading room.

Key Words: Education; technology; millennials; residency; fellowship; medical student.

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BACKGROUND

Most of today's radiology trainees belong to millennial or Generation Y. The term millennial generation was first used by William Strauss and Neil Howe in 1991 (1). Although precise definitions of the generation vary, demographic studies sometimes categorize Americans born between the years 1982 and 2001 as millennials (2). My¹ generation grew up with the explosion of technology in daily life, immersed in always-on notifications, social media, and memes, and my childhood memories were punctuated by the 9/11 terrorist attack, the war in Iraq, and school violence. Today, we have entered the workforce *en masse*, surpassing Generation X to become the largest employed American age group according to Pew Research Center (3). In academic radiology, my generation now comprises your medical students, residents, fellows, and junior staff.

Millennials crave active engagement, multimedia learning, and continuous feedback (2). Therefore, much published work exists on how to innovate modern education for these needs. In a flipped classroom, students prepare outside of class and focus in-class learning on critical thinking (4). An abundance of "podcast" lectures—prerecorded audio or video discussing a focused topic—and educational websites brought to life the promise of massive open online classrooms. Digitized lectures personalize learning to the speed of the learner who can repeat, fast-forward, or skip through content (5,6). The availability of low-cost personal computers and smart

devices enabled computerized simulation and gamification of learning not only in general education but also specifically in interventional and diagnostic radiology (7–10). With a myriad of these learning modalities, engaging my generation to learn would seem easier than ever.

However, an overemphasis on technology without considering the millennial learning pattern can backfire. Increasing data show teaching the millennial learner is more than deploying as many of these novel approaches and technology as possible. A survey of millennial medical students shows that when asked to identify the ideal mix of "flipped vs lecture," only 8% of respondents prefer a 100% "flipped" learning model; in contrast, a majority of the respondents prefer a predominantly lecture-based system (11). Additionally, although some prefer to watch lecture videos at 1.5× playback speed, evidence shows that higher playback speed correlates with lower knowledge retention (6).

In this manuscript, we share our experience as a millennial who was a recent resident and fellow and a long-time educator and mentor of millennials. Although we too have implemented many of these novel techniques, examples of our best educational successes come from leveraging new technology such as online resources, new software, and social media mechanics to support traditional learning approaches such as setting specific goals, teaching relevant facts, giving feedback, and others. Table 1 describes a summary of the approaches.

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¹Although one of the authors (M.H.S.) technically belongs to a different generation, this article is written primarily by and in the voice of the millennial author (P.-H.C.).

ENGAGING MILLENNIAL RADIOLOGY TRAINEES

Set Specific Goals

Millennials set high standards for themselves and are optimistically motivated by their abilities (12). In a meta-analysis of survey studies focused on the millennial generation, researchers find that the higher assertiveness and self-expectations of this age group come at the cost of a larger

TABLE 1. Summary of Our Approaches to Engage Millennial Trainee

Topic	Recommendation(s)
Set specific goals	<ul style="list-style-type: none"> • Leverage the ACGME requirements and milestones • Create SMART goals from broad requirements • Establish a mechanism for assessment and attestation
Leverage technology to emphasize relevance	<ul style="list-style-type: none"> • Use teaching moments during on-service readout to search the Internet or institutional database for similar cases, pitfalls, and related concepts • Use discrepancy detection software to show differences between final attending and preliminary trainee interpretations • Establish a safe environment to allow trainees to share missed cases • Create a teaching file of useful cases by soliciting trainees to earmark cases they find educational (ie, "crowdsource")
Give formative feedback	<ul style="list-style-type: none"> • Give feedback on specific actionable ways to improve during on-service readout or after a procedure
Create transparent assessments	<ul style="list-style-type: none"> • Give benchmarks on objective expectations such as volume of interpretation or procedure • Create mechanism to provide frequent reporting on important metrics such as MQSA
Encourage self-development	<ul style="list-style-type: none"> • Support academic endeavors with time and funding

ACGME, Accreditation Council for Graduate Medical Education; MQSA, Mammography Quality Standards Act; SMART, specific, measurable, attainable, realistic, and time-bound.

gap between the expectation of achievement and the effort necessary to achieve it (13,14). Therefore, explicit goal-setting may be valuable in focusing the stress of learning radiology onto specific tasks and in bridging the gap between expectations and competency. The competency-based medical education and the Accreditation Council for Graduate Medical Education (ACGME) Diagnostic Radiology Milestone Project have created broad guidelines of competency designed for resident performance (15).

Although ACGME only broadly defined the goals of Milestones because of the complexity of individual subspecialties, we have found that junior residents respond better when guidance is provided in the form of specific tasks. Specifically, we converted each ACGME Milestone to a set of SMART goals which stand for specific, measurable, attainable, realistic, and time-bound (16). SMART goals and targeted feedback have been described as best practices for millennial learners (17). In our residency program, the program director and chief residents work with ongoing junior resident input to maintain a comprehensive, itemized list of tasks that should be completed for each iteration through each subspecialty rotation. Measurability is performed either as a web-based quiz or by self-attestation. Attainable goals are frequently marked as required, whereas those requiring an in-depth dive are not. Therefore, items in the list are separated into "required" and "strongly recommended." Table 2 provides an example of expected goals for the first rotation through body computed tomography, which consists of a combination of reading material and practice quizzes either from a trusted online source or created by our faculty.

To create realistic expectations, we do not set volume-based goals by rotation but provide residents a resource to review their volumes and benchmark with the aggregate record of previous residents (discussed in the following).

TABLE 2. Example of Specific Goals for First-time Rotation Through Body CT

Required

RSNA physics radiation dose in CT
 Select the protocols for 360 CT examinations
 Start the Basic GU&GI online quiz (to be completed by June of R1 year)
 Complete SAM on the topic: Administration of Iodinated Contrast
 Complete Quiz on Contrast Reaction

Strongly Recommended

Complete RSNA physics online module: CT Image Quality and Protocols
 Review the 20 Must See First Year Cases found in the Body CT rotation packet

CT, computed tomography; GI, gastrointestinal; GU, genitourinary; RSNA, Radiology Society of North America; SAM, self-assessment module.

To close the loop and provide feedback in ACGME goal-setting, we also created a low-cost, semiautomated software allowing residents to attest to their completion of a module, the details of which were published previously in this journal (18). The Milestone software also allows faculty to evaluate the state of resident performance after conducting an interventional procedure. The timely completion of these specific goals and assessments aids in the semiannual review of resident competency.

Leverage Technology to Emphasize Relevance

The millennial generation spends much of their childhood immersed in omnipresent technology. Within seconds of

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