

Medical Student Education

Student-created Independent Learning Modules:

An Easy High-value Addition to Radiology Clerkships

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Rationale and Objectives: Modern radiology clerkships require a rigorous, in-depth curriculum usually involving a variety of educational activities. With increasingly constrained faculty time and departmental resources, finding activities that are easy to implement and of high educational value can be a challenge.

Materials and Methods: We introduced a novel educational activity to our radiology clerkship in which students created independent learning modules (ILMs) that were reviewed by their classmates. Feedback surveys were used to assess the activity and guide a revision to the program. Feedback surveys after the revision were used to assess the overall perceived value of the program.

Results: Twenty-seven students in two successive sessions of our elective radiology clerkship completed the ILM activity and provided feedback. Sixty-four students in five subsequent sessions completed a modified version of the activity and provided feedback. Students in this final group rated the activity's educational value at 8.3/10, with most describing both the creation and reviewing of the ILMs as similarly or more educationally valuable than lectures (41 of 64 [64%], 48 of 64 [75%], respectively). Students indicated the target ILM length of 15 minutes was "about right" (61 of 64 [95%]), and that the overall proportion of the course dedicated to the ILM activity was appropriate (49 of 64 [77%]).

Conclusions: A novel student-created ILM activity was highly reviewed by radiology elective students, both with regard to the educational value of creating and taking the ILMs. Clerkship directors wishing to supplement their curricula with an easy-to-implement high-value activity may consider adding a student-created ILM assignment.

Key Words: Independent learning; modules; clerkships; ILM.

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The need for high-quality, engaging, and rigorous radiology clerkships has never been greater.

First, students demand it. Modern medical students come to medical school with extensive experience with digital resources (1–3). While in the preclinical years of medical school, students are increasingly exposed to nonlecture learning formats, including e-learning, problem-based learning sessions, small-group sessions, and workshop style formats (4–8).

Second, our courses must be high value to support the broader mission of radiology affirming its value within the health care enterprise. A growing trend toward value-based care necessitates greater emphasis and education as to radiology's contribution to efficient patient care (9–11). A well-designed

radiology clerkship that emphasizes the role of radiology, proper ordering of imaging examinations, and a judicious use of imaging, rather than interpretation skills (which are the domain of radiologists), can help achieve this goal.

While the need for engaging and educational clerkships is increasing, the resources available to support these efforts are decreasing (12). Declining reimbursements and strained department finances combined with the ever-present paucity of faculty time make adding time-intensive or financially costly activities near impossible. This leaves the modern radiology clerkship director in a challenging position: how to develop an ever more rigorous curriculum with little faculty time to spare.

Unfortunately, the solutions readily available are limited. Educational resources that do not require direct faculty teaching time often are expensive, are too limited in scope, or are actually more appropriate for future radiologists (eg, radiology residents) than for future referring physicians (eg, most senior medical students). Although resources from outside institutions or vendors may be available, use of these resources can reflect poorly on the course in the eyes of the students, and sometimes, the medical school administration.

Herein, we describe a structured curricular innovation that satisfies a number of desirable criteria. It is (1) educationally

Acad Radiol 2014; ■:1–9

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<http://dx.doi.org/10.1016/j.acra.2014.01.024>

valuable, (2) requires targeted and predictable faculty time, (3) presents an interactive challenge to students which can integrate and solidify individual student experiences, (4) involves a digital learning format that exercises a student's ability to use these critical systems, and (5) encourages peer-to-peer interaction.

The activity involves students creating independent learning modules (ILMs) designed to be shared with their classmates. Our research describes the learning activity in detail, as well as measured assessment using online feedback surveys for a consecutive 7 months of use. We hypothesized that such an assignment would occupy a substantial portion of the students' nonlecture time and would ultimately be viewed as a valuable educational activity.

MATERIALS AND METHODS

Assessing the Need

Our main radiology clerkship is an elective taken by approximately 90 of our 150 senior medical students each year. The clerkship runs for 4 weeks, enrolls approximately 10–18 students per session, and includes approximately 70 lecture hours. In addition to lectures, students participate in tours, hands-on ultrasound scanning sessions, and ultrasound-guided procedure practice sessions, and with less emphasis on passive reading room observation. There is an end of the course assessment with a 1-hour examination. The course is graded on a pass/fail scale with student-specific comments provided to the dean's office.

Despite this list of varied activities and the wide variety of lectures, we assessed the breadth and depth of the course content, the overall student effort, and time committed and determined that additional activities were required. Initially, we used commercially available CD-ROM-based modules that were available in our department, originally purchased for resident use. These were soundly criticized by our students as being the least valuable activity in the course, with the primary complaint being the material was above their level and focused more on image interpretation than reviewing radiology basics and proper ordering. This static resource was also increasingly criticized for being out of date and seemingly "old".

Given resource limitations, most notably faculty time constraints, we sought new self-directed activities to improve the course value and potentially increase a given student's ability to target topics of personal meaningful value/interest.

The "Student-Created Independent Learning Modules" Solution

Students creating ILMs was conceived as a way to develop level-appropriate modules, while also providing an educational opportunity in and of itself. The creation of a module not only requires an in-depth understanding of a topic but encourages development of self-directed learning skills and use

of technology, both of which will be needed in their subsequent training. An educational activity whereby students create modules and subsequently review the modules of their classmates seemed to offer a number of potential benefits, listed in the following. The final structure of the assignment (discussed in the next section) was designed to maximize these potential benefits:

- Creating ILMs can be educationally valuable and exercise new learned skills: To create an ILM, a student must first learn a topic well enough to teach it. Further, they must use a multimedia approach in their preparation of the content. Both of these approaches have been shown to improve retention of material, and if the topic is relevant to their future career, this can be highly valuable (13–16). In addition, learning how to teach can be valuable for physicians in many practice environments (17), and a skill required in most postgraduate training programs overseen by the Accreditation Council for Graduate Medical Education (ACGME).
- Reviewing and critiquing ILMs developed by peers can be valuable: Modules created by peers have the advantage of being level appropriate. Experts in a subspecialty typically have a more complex knowledge structure compared to their students. A teacher with a more similar knowledge framework may be able to better anticipate the needs of the learners (18). While not an absolute rule, research has shown peer-to-peer teaching and near-peer teaching (19–21) often offers unique benefits, including "cognitive congruence" (22). In addition, reviewing ILMs made by peers during the same clerkship can ensure relevant and up-to-date topics and information.
- A student-created ILM activity requires less collective faculty time: The course director or other faculty member should introduce this activity and guide students; yet fortunately, a large portion of the instruction can be written and achieved through example ILMs. Faculty time is required in assessing the modules. Although peer grading can be less objective, it has been validated as an assessment technique (23), and asking for peer feedback can provide a great deal of useful information to the faculty as they assess the ILMs.
- Materials required are essentially cost free: if students have access to computers and presentation software (usually Microsoft PowerPoint), the creation of the modules should be without cost. Other less-ubiquitous presentation platforms can also be used, but these are often not free, are less familiar to students, and can limit the ability of the student to use or review their product at a later time.
- "Add-on" activities are possible: After making an ILM and reviewing their classmates' modules, other activities are possible. For example, students can present additional information during in-person presentations, or a "quiz question" session could be added where students try to answer questions from each other's modules. In addition, vetted or faculty-created questions based on module content could be added to an end of rotation examination.

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