

Leveraging Educational Technology and Evidence-Based Education to Improve Outcomes in Pathology Residency Education

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Introduction

The AP/CP residency at The Mount Sinai Hospital Department of Pathology is one of the largest residency programs in the country. While the size of the program offers a number of strengths, particularly with the ability of residents to assist in developing their own education, some aspects of resident education were underdeveloped. A coalition between residency program administrators and the residents was formed to identify areas of improvement. Consistent themes of improvement were identified across the curriculum, and a broad-based intervention was needed to bolster existing strengths while minimizing and fixing existing weaknesses in the program.

To manage both functional and educational goals, we began implementing a blended learning model. In a blended learning curriculum, some learning materials, often the factual knowledge, are placed online as videos or text that the resident reviews in a time and place of their choosing, leaving the time spent interacting with the lecturer to be more engaging and interactive. This also increases the responsibility of the resident for their own learning. Additionally, blended learning technology allows attendings to use instructional scaffolding, where the attendings can tailor the amount of help residents need based on resident skill level and understanding, with this assistance decreasing as autonomy increases. Blended learning has been described as a tool to address weaknesses found using the SLT model.³

	Utility of didactics	Desire to attend
AP traditional lectures	4.8	4.8
AP unknowns	4.7	4.8
AP team-based learning	4.4	4.5
CP traditional lectures	3.9	4.0
CP unknowns	4.0	4.2
Professional development	3.7	3.6
Friday case conferences (MSCV)	4.4	4.4

Table 2. Resident perceptions of each didactic component (5-point Likert, n=23)

	Residents	Attendings
Faculty have modified teaching style	60% (13/20) yes	79% (11/14) yes
Faculty are more interested in teaching	60% (13/20) yes	65% (9/14) yes
Resident engagement has improved	79% (15/19) yes	79% (11/14) yes
Overall opinion of the new curriculum	4.5 (n=23)	4.5 (n=14)

Table 3. Attending and resident perceptions of the new curriculum.

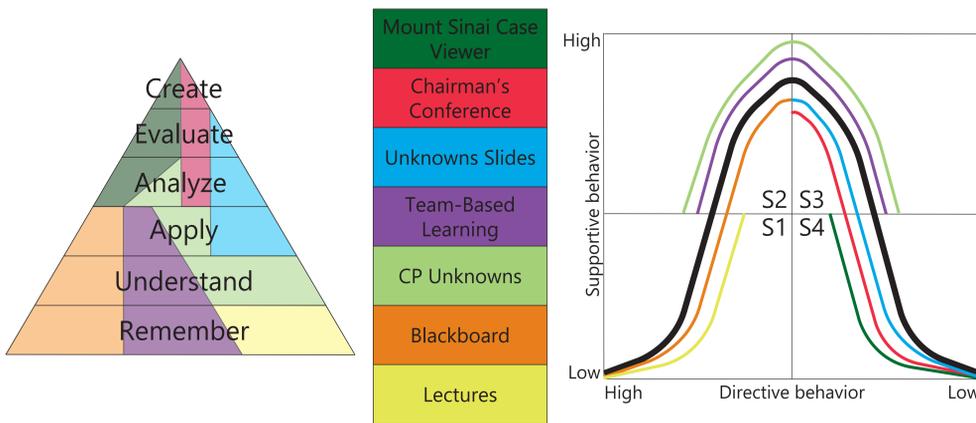


Figure 1. Schematic representation of educational goals (overlaid onto Bloom's taxonomy, left) and functional goals (overlaid onto Hersey and Blanchard's situational leadership theory, right).

Planning

Higher medical education ideally uses different conventional pedagogic modalities than those employed by most institutions of higher education. Learners (doctors) are expected to be able to perform challenging tasks and understand difficult material while also promoting a mental skillset that allow for self-directed learning. Additionally, many learners are adults, meaning that alternative teaching methods are necessary. Adult learning requires that the learners have autonomy in their own education, often by understanding the relevance of the information they are learning.¹ Educating a doctor should allow the educators (attendings, more senior residents, and other key stakeholders in residency education) to perform as a "moderator" rather than a person who bestows knowledge on the learner.² We started our planning with the desire to teach residents to be self-sufficient in their learning and realizing that medical residents are adults and must be taught as such; this premise would necessarily involve an approach that involves residents and those who educate them.

We used two conceptual frameworks to organize our thoughts and goals with the curriculum change, which we separated into "functional goals" and "education goals." While there is overlap between the two, the functional goals were primarily used to increase the residents' ability to function as resident physicians, while the education goals were used to change the structure of the didactics.

The conceptual framework that we used to direct the functional goals was Hersey and Blanchard's situational leadership theory (SLT). In this model, learners begin at a low-maturity, low-skill level and progress to a high-maturity, high-skill level. At the beginning of their residency education (D1), resident physicians need direct, programmed instruction (S1), more matching the behaviorist philosophy of education. At this stage, residents are unconsciously incompetent—they don't have enough knowledge to even understand how little they know. The next step is to begin integrating the knowledge they have gained with application. In the personal experience of the authors, many pathology residents perceive a "dip" in performance once they have learned a significant amount of factual knowledge, as they know a significant amount about various disease entities but don't know how to parse the information and effectively use the knowledge to find the correct diagnosis. Thus, this stage (D2) requires more support from faculty as residents need more advanced educational methods (S2). In the third stage (D3), residents still lack the ability to act on their own, but are more highly motivated to pursue their own educational goals; faculty provide methods to encourage resident self-direction (S3). In the last stage (D4), residents should have the ability for self-directed learning. They should be competent enough to have tasks delegated to them, and they should be competent enough to create content to educate each other (S4).

For the educational goals, we used Bloom's taxonomy. At the earliest stage of learning information, students remember individual facts but do not understand how they relate to other facets of information or how to apply the information. As their understanding progresses, they begin to understand the content, how to apply it, and will eventually learn how to evaluate nuance and use the information they know to create new information.

Implementation

In summary, we implemented the following changes:

- Created a dedicated environment (an "organization") for the pathology residency within the medical school's learning management system, Blackboard (Blackboard, Inc.).
- Recruited resident volunteers for each sub-specialty, who would work with the attendings to create learning objectives, establish resident expectations, upload existing learning materials, and assist the attendings with their didactic responsibilities.
- Set up video recording software to catalog all lectures, along with a PDF copy of each lecture; both are uploaded into Blackboard.
- Obtained a PathPrimer and ExpertPath (Elsevier) subscription for each resident, which they are supposed to review before didactics.
- Established a new schedule for didactics (table 1).

Monday AM	Tuesday AM	Wednesday AM	Thursday AM	Friday AM
<ul style="list-style-type: none"> • AP traditional didactic lectures • Recorded to YouTube • Embedded in Blackboard along with lecture PDF • Will likely be phased out in 2018-19 	<ul style="list-style-type: none"> • CP traditional didactic lectures • Recorded to YouTube • Embedded in Blackboard along with lecture PDF 	<ul style="list-style-type: none"> • Cytology didactic lectures (1/2018 - 6/2018) • Recorded to YouTube • Embedded in Blackboard along with lecture PDF 	<ul style="list-style-type: none"> • Team-based learning (same topic as Monday) • Seven groups of four • Attending-created quiz in Blackboard • 30 minutes taking test as group, 30 minutes of discussion with attending 	
Monday PM	Tuesday PM	Wednesday PM	Thursday PM	Friday PM
<ul style="list-style-type: none"> • AP unknowns slides (same topic as AM) • Digitized and uploaded into the whole slide imaging server • Data is de-identified (can take home or download after graduation) 	<ul style="list-style-type: none"> • CP resident-led unknowns • Boards-oriented • Recorded to YouTube • Embedded in Blackboard along with lecture PDFs (questions and answers) 	<ul style="list-style-type: none"> • Professional development conferences • Topics including CV creation, article discoverability, effective computer use • Recorded to YouTube • Embedded in Blackboard along with lecture PDF 	<ul style="list-style-type: none"> • AP unknowns slides (anything in sub-specialty) • Digitized and uploaded into the whole slide imaging server • Data is de-identified 	<ul style="list-style-type: none"> • "Rapid-fire" case conference • Presented using the Mount Sinai Case Viewer • Some Fridays are concept-based conferences ("Chairman's Conference")

Table 1. Overview of the new didactic schedule.

Results

After the curriculum changes were made, we sent out surveys to residents, attendings, and observers of the program, which contained five-point Likert scale questions and short answer feedback. The results can be found in tables 2 and 3, and they were generally positive. Of note, the residents generally felt that the curriculum had been improved (4.5/5.0, n=23), that the new didactics were more boards-relevant (4.5/5.0, n=23), and non-first-year residents thought that RISE scores would likely improve (4.4/5.0, n=16). Attendance at the didactics sessions also rose dramatically (figure 2).

There were limited open-ended responses, but for those that were submitted, some consistent themes arose. For both faculty and residents, there were concerns about the amount of time being spent in the new curriculum, particularly in making time to attend the lectures when residents are on external and frozen section rotations, and in modifying sign-out times.

Observers of the program also approved of the changes, rating 4.5 (n=11) for both the overall curriculum and that the curriculum shone a positive light on the program. Interestingly, those observers who had previously completed a pathology residency and/or had observed other pathology programs (4/11) gave higher ratings than the others, most of whom were medical students who were not interested in pursuing pathology as a specialty.

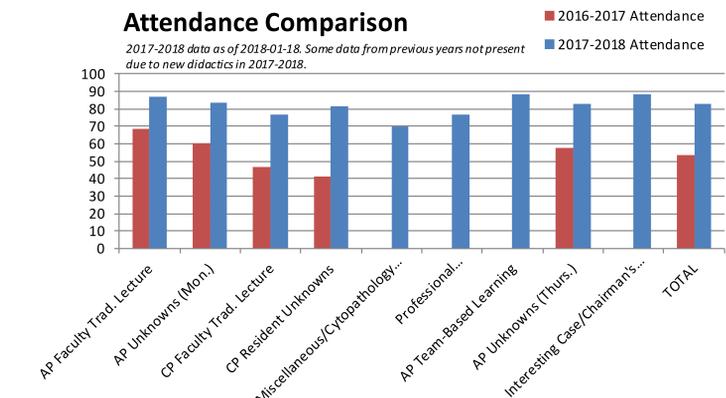


Figure 2. Attendance changes as of January 18, 2018.

Conclusion

While much of the initial effort towards reforming the curriculum was centered on the labor of a couple of select individuals, some steps have been taken to ensure that the changes are sustainable. The management of Blackboard, including recording videos and organizing material, is largely borne by departmental support staff. Additionally, the changes to the AP didactics have been accepted by residents and faculty to the point where they are willing to ensure that lectures, unknown slides, and team-based learning questions are completed before their respective presentation weeks. However, the digitization of unknowns slides and the management of the Mount Sinai Case Viewer remain technically challenging and are not yet independently stable.

After all traditional lectures are recorded, we can replace these lectures with another unknowns session, team-based learning session, or begin using a different modality like problem-based learning. We also intend to improve existing modalities. The unknowns digital slides will soon need a new server, and a newer software should be created to improve the efficiency with which residents can review the slides. The Mount Sinai Case Viewer could accept whole slide imaging uploads to display with the cases, and a study mode could be created for residents to create study sets using the cases presented therein. Some residents find spaced repetition software to be particularly useful as a memorization technique; we could create digital flashcard sets that integrate with the current curriculum and prevent memory loss while the residents are away from a specific sub-specialty.

By using concepts of adult education, we were able to implement a curriculum that allows for resident self-determination in their learning. A blended learning approach is ideal for a pathology residency program and maximizes learning opportunities while archiving assets for learning use.

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