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Successful integration of thyroid cytopathology and surgical pathology education in an E-module format

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ABSTRACT

Context: The shift to digital learning in medicine is well underway and in fact spurred by the COVID-19 pandemic. The didactic portion of our institution's cytotechnology (CT) education program is online and delivered to learners across the nation. With CT education elevating to the master's degree level, there is a need to expand cytologic correlation with surgical resection specimens. We also wanted to afford pathology residents the same.

Methods: We developed an online cytologic–histologic correlation digital learning module (e-module) addressing thyroid fine needle aspirations (FNAs) and surgical thyroidectomy specimens which was administered as part of coursework in the CT education and pathology residency programs. The module was 35 min long and consisted of guided narration with both formative and summative interactive quizzes. After completion of the module, participants were invited to fill a brief survey comprised of multiple choice, Likert, and free response questions. This study was approved by the institutional review board.

Results: The 29 respondents were comprised of 22 CT students and 7 residents. CT students had minimal experience thyroid pathology prior to the module; residents were mixed. Twenty-three (79.3%) ranked the highest tiers for learning cytopathology through this module, 24 (82.8%) for learning thyroid surgical pathology, and 25 (86.2%) for cytologic–histologic correlation. All respondents stated they would like similar activities in the future.

Conclusions: Teaching cytology–histology correlation for thyroid in an electronic format was effective and well-received by participants. There is a demand for these activities among current learners, suggesting that expanding the available repertoire will be beneficial.

Introduction

Educational activities primarily by electronic and computer-based mechanisms, termed e-learning, has revolutionized pedagogy with the ability to bring coursework to any location with internet or satellite access.[1,2] Its importance has magnified exponentially during the ongoing COVID-19 pandemic, with a rapid pace of adoption in primary through professional education and in both resource-rich and resource-poor environments.[3–5] In the post-graduate education realm, our institution has excelled, even before March 2020. The Cytotechnology Education program has graduated approximately three dozen cytotechnologists who performed their didactic coursework exclusively electronically over the past ten years with a 100% board examination pass rate and with published demonstrations of equivalency between in-person and virtual learning.[6,7]

The ability to communicate health-related concepts by electronic means takes particular importance in the COVID era, where the allowance for and the utility of telehealth visits have rapidly increased[8] and an ever-increasing proportion of healthcare communication is likely to moved to an electronic format.[9] Particularly for pathology and pathology-related fields, the necessity of, and problems with, electronic communication has remained a major burden for effective information sharing between technologists in multiple fields, pathologists, the healthcare team, and patients.[10–12] Of course, this is generalizable to the general medical establishment, but the image requirements in anatomic and cytopathologic education lend themselves particularly well to online image-based mechanisms of distance education.

Further, with cytotechnology education elevating to the master's degree level, there is a need to expand cytologic correlation with surgical resection

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specimens. We also wanted to afford pathology residents the ability to do the same correlative activity.

Methods

We developed an online cytologic–histologic correlation digital learning module (e-module) addressing thyroid fine needle aspirations (FNAs) and surgical thyroidectomy specimens which was administered as part of coursework in the thyroid section of the CT course and the cytology rotation in the pathology residency program at our institution. From the archive of cytology slides at our institution, up to 3 cases with up to 7 low- and high-power fields demonstrating prototypical features were selected for each of benign thyroid, lymphocytic thyroiditis, follicular neoplasm, Hurthle cell neoplasm, papillary carcinoma, medullary carcinoma, and anaplastic carcinoma according to current criteria.[13] Surgical pathology cases from an archive of greater than 40 years, including all available matched (e.g. same procedure, or same patient with subsequent procedure) surgical slides to the selected cytopathology cases, were independently investigated and selected. When possible, the matched cases were ultimately chosen, but for the majority of cases, every desired diagnostic feature was not available in the matched cases, so the cases which together best demonstrated all desired features were included. Case images included H&E-, Diff-Quik-, Papanicolaou-, and immunohistochemistry-stained slides as appropriate.

Cytopathology and surgical pathology images were acquired on an iScan HT Scanner (Ventana Medical Systems, Tucson, AZ) at 40X magnification. Images were viewed and annotated in mScope, v. 3.5 (Aurora, Montréal, Quebec, Canada). Audio recordings were saved as mp3 files, and the module was assembled in Articulate Storyline 3 (Articulate, New York, NY). The module was 35 min long and consisted of guided narration covering non-neoplastic and neoplastic thyroid cytopathology, surgical specimens, and matched cytology/surgical specimen comparisons. Both formative and summative interactive quizzes were included during and at the end of the module. After completion of the module, participants were invited to fill a short electronic survey comprised of multiple choice, 5-tier Likert, and free response questions. Statistical analyses were performed in Graphpad Prism, v. 9.3.1. This study was approved by the institutional review board (795-20-EX).

Results

The coursework and survey were administered over a two-year period to 43 learners including 33 CT students and 10 pathology residents. Representative images from the module are provided in Fig. 1. Twenty-nine total responses were recorded (67.4% of administered), composed of 22 CT students (66.7% response rate) and 7 residents (70% response rate). Respondents were asked about technical issues related to access and audio/video activities; all 29 respondents (100%) were able to access the module, hear and understand the cytology portions, and hear and understand the surgical correlative portions.

Respondents were asked about their prior experience with thyroid cytology and surgical pathology. Of 22 CT students, 19 (86.4%) had “minimal to none,” two had “at least a couple of months,” and one had “more than a few months” (Fig. 2A). The seven residents had more varied experiences with thyroid cytology, with only two (28.6%) in this minimal category (Fig. 2B). Similarly, for surgical pathology experience, 19 CT students (86.4%; Fig. 2C) had “minimal to none” while residents were varied (Fig. 2D). Seventeen of the 19 CT respondents (89.5%) had “minimal to none” responses for both categories.

Respondents were then asked to rank separately the utility of the module for learning thyroid cytopathology, learning thyroid surgical pathology, and communicating the cytology/histology correlation on a five-tier Likert score. These individual responses are presented in Fig. 3. For cytopathology, CT students had a median of 5 (the highest score) and a mean of 4.4. Residents were similar with a mean and median both of 4. For surgical pathology, CT students demonstrated a median of 5 and mean of 4.5, with residents slightly lower, at 4 and 3.7, respectively. Finally, for the utility of cytology/histology correlation, CT students had a median of 5 and mean of 4.6 while residents had a median of 4 and mean of 3.8. Given the markedly right-skewed distribution of Likert ratings, Mann–Whitney tests comparing the lowest-tier respondents to all others were performed for previous cytology experience, previous surgical pathology experience, and learner specialty. No significant relationship was identified (all $P>>0.3$).

Open-ended, non-compulsory questions asked respondents to mention portions of the module which they viewed particularly positively and negatively, and a separate section for any additional comments was provided. Nineteen respondents (65.5%) inputted text in any of these fields for a total of 42 responses. Of the 16 responses for the positive question, 15 (93.8%) indicated good reviews of the correlative activity, in particular citing the interactivity and side-by-side comparisons. One respondent specifically mentioned the ability to choose a new answer in the quiz sections. For the 17 responses to the negative question, 10 (58.8%) respondents filled “no” or “N/A,” and four reiterated the statements in the positive question. The substantive responses were about time, specifically for increasing the speed of narration and for video editing. One respondent thought higher magnification for some images would have been helpful. For the 9 filled final additional comment section, 6 (66.7%) responses were “N/A” or similar. Two responses demonstrated gratitude for creating this module. One response iterated a request for video editing.

Finally, respondents were asked whether they would be interested in cytology/surgical pathology correlative modules in the future. All respondents (100%) stated that they would want to participate in similar activities.

Discussion

We designed an electronic module to compare thyroid FNA cytopathology and surgical pathology specimens for CT students and pathology residents at our institution. The module and an optional survey were administered over two years to 43 learners, and 29 (67.4%) completed the survey.

Most CT respondents had minimal prior exposure to thyroid pathology specimens. Resident respondents, however, were more evenly distributed from minimal to significant exposure. This likely reflects the different course of training the two groups receive; CT students at our institution have nine months of contiguous cytology didactic sessions organized by organ or system, whereas residents have once-yearly cytology rotations which simultaneously encompass all organs. The survey was administered to all levels of pathology residents and not just those rotating in cytology for the first time. As such, the CT students had very little exposure to thyroid cytology before this course, but residents who had already completed their first cytology rotations already had intensive work in this organ. No statistically significant relationship was identified that subcategorizes the learner types, suggesting that despite the reported greater familiarity with the thyroid, residents still felt overall that they benefited from the module. This is borne also by the numerical and free response data.

The module delivery mechanism and content received overwhelmingly positive feedback (Fig. 2). The great majority of respondents gave very high ratings and resounding free response praise for the cytomorphology, surgical pathology, and most importantly the cytology/histology correlative portions. Remarkably, although the respondents with lowest-tier responses tended to have more experience in both surgical and cytopathology, statistical significance was not reached. Also remarkably, all respondents, despite the poor numerical ratings, still stated they would want to see other similar cytology/histology modules.

Our survey was designed to assess attitudes and subjective outcomes as rated by participants. No knowledge-based or objective assessment was included. This is because this module was not intended to replace any part of the standard CT or resident training which contain their own internal mechanisms of assessment; it was simply to augment our institution’s current offerings. As such, the metrics by which success was interpreted was by our ability to assemble the module and the buy-in of the participants.

The e-module may need updates or changes as our fields update and change. As diagnostic criteria evolve, we will need to assess any issues that

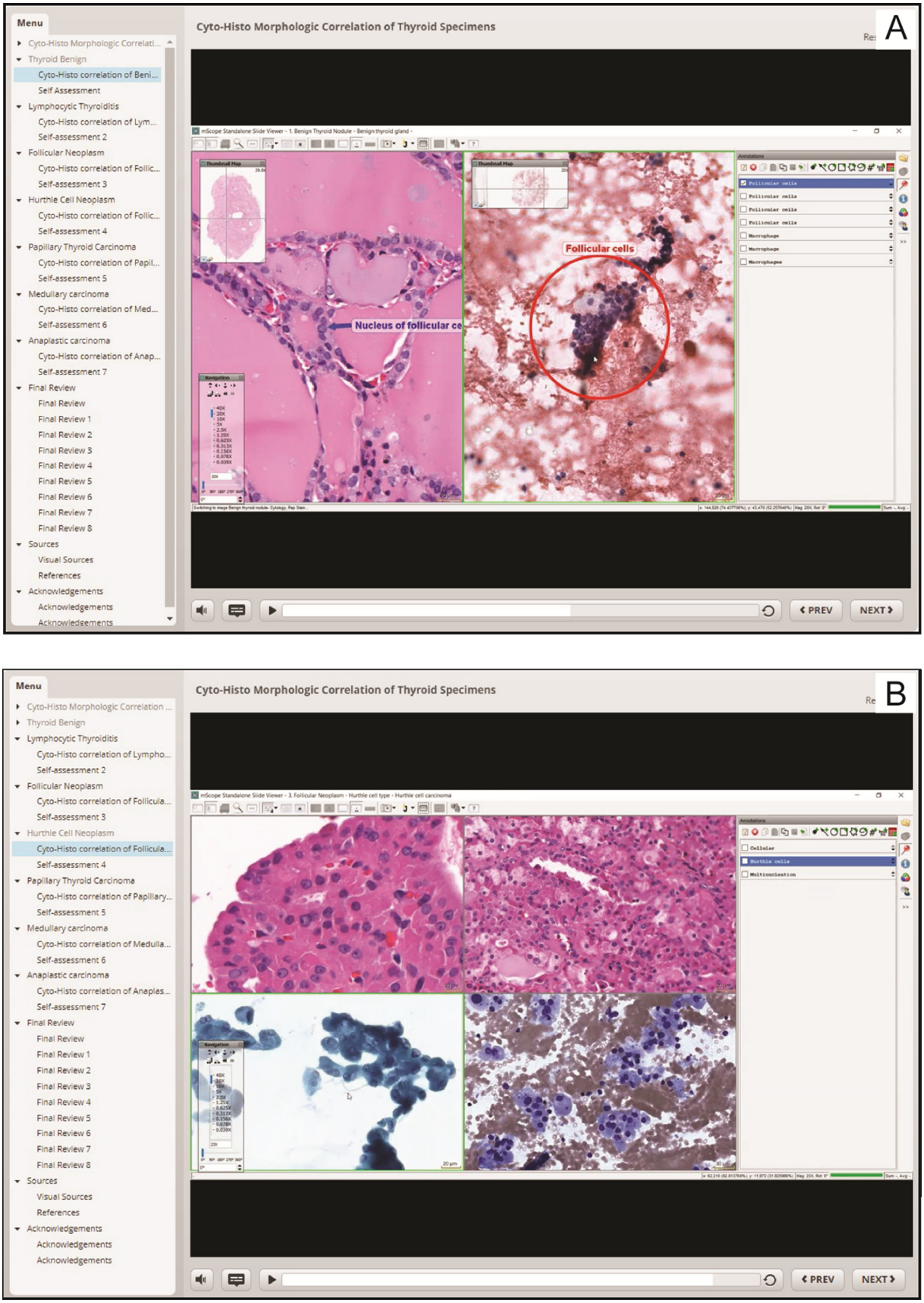

Fig. 1. Images from e-module. (A) Screenshot from the benign thyroid section demonstrates the selection of annotated follicular cells during the narrated portion. (B) Screenshot of the Hurthle cell neoplasm section without annotations selected. The leftmost panel in the module allows for individuals to jump between sections.

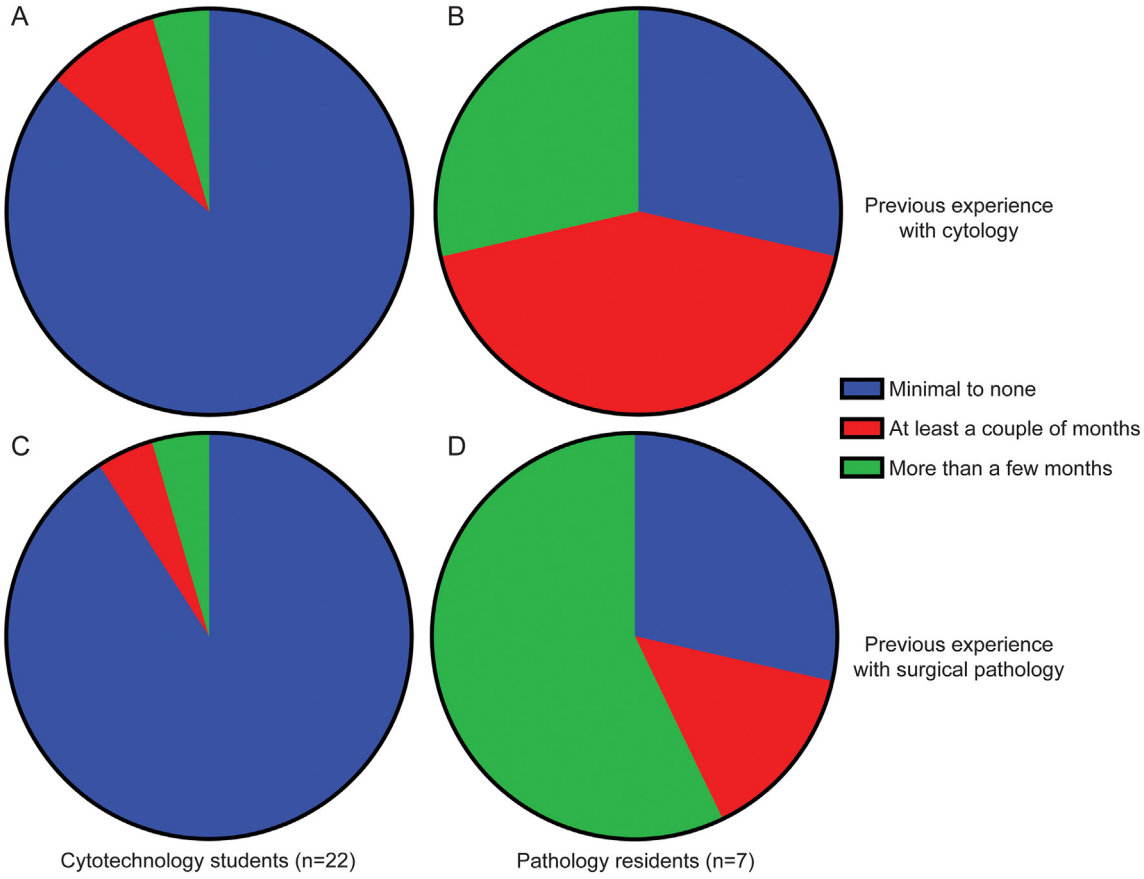

Fig. 2. Previous exposure of respondents to thyroid cytopathology or surgical pathology by training program. (A, C) Cytotechnology (CT) students' previous experience with thyroid cytology and surgical pathology, respectively. (B, D) Pathology residents' previous experience with the same. The great majority of CT students did not have previous exposure to either field, whereas residents were mixed.

arise. The most obvious possible point of change will occur when the Bethesda system[13] is updated. At that time, we may need to alter or retire the module depending on the degrees of difference from the prior criteria. All pedagogical resources, both electronic and printed, by necessity have the same risk of obsolescence, especially in such a rapidly evolving field as medicine. We argue that this should not deter from the use of electronic teaching tools, but even more should not deter from the creation of these resources.

A straightforward extension of thyroid pathology e-learning is primary electronic practice and signout. The last five or six years, and indeed the last six months, have seen numerous studies examining the efficacy of digital mechanisms in thyroid cytopathology and surgical pathology practice comprising both pathologist-driven (e.g. computer-aided) and computer-driven (e.g. computer-performed) diagnostics, which together demonstrate acceptable statistical agreement with non-digital diagnosis.[14–19] Girolami et al.[14,15] note that the use of these technologies in thyroid investigation is still in its early stages. Progression to an accepted digital model with wide applications can only occur with wide acceptance. Therefore, learning modalities such as what we created here start individuals' multimodality comfort at the earliest stage of training and can serve to prepare learners for rapidly changing practice in their fields.

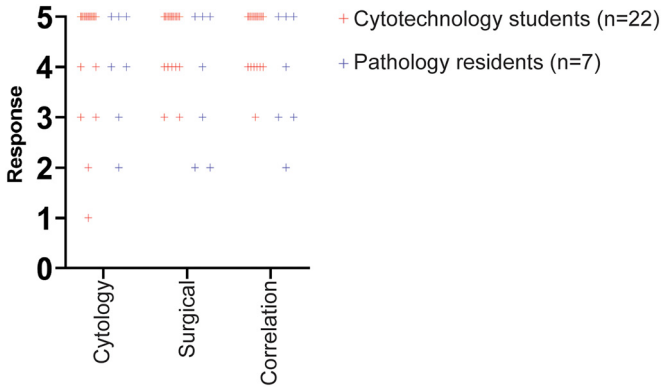

Fig. 3. Respondents' responses to utility of the e-module by training program. The majority of all respondents, including both CT students (red) and pathology residents (blue), gave the highest possible rating to the module's communication of cytology, surgical pathology, and correlative concepts.

Conclusions

Together, these data provide strong further support for electronic learning in CT and surgical pathology education. The presentation of these concepts was effective and meaningful for pedagogical and communication goals in the digital world. Ultimately, this course was successful in creating the correlative activity we intended. As it is already integrated into our CT and resident education courses, we feel that this provides a justification for further expansion of electronic modules in cytopathology education and can apply to primary medical education in a variety of fields.

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Declarations of Competing Interest

None.

Conflicts of interest

The authors declare no conflict of interest.

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