Zooming into the COVID Era Together

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Abstract
The pre-clinical medical school curriculum provides students with extraordinary experiences in preparation to become physicians. However, it was not originally designed to be delivered remotely. The COVID-19 pandemic promptly threw the medical education process into unforeseen circumstances. A model of student–faculty collaboration created to address new challenges and implement practical solutions rapidly is presented. This model was used effectively to respond to pre-clinical educational interruptions that were imposed by the COVID-19 pandemic and maintain high-quality training. Our experience provides valuable insights and lessons learned that can be applied to the ongoing pandemic response and to future educational challenges.

Keywords Medical education · Education · Teaching · Learning · Curriculum · Faculty · Case based learning · Distance learning · Virtual learning

Introduction
The majority of traditional medical education is centered around in-person learning modalities. Typically, upper-year students learn primarily through their role as a member of a clinical team in an out-patient or in-patient setting. Pre-clinical students rely on experiential activities paired with close interactions with faculty, including a variety of formal and informal small group activities [1]. The structure of the medical school curriculum is highly coordinated and planned far in advance because its success depends on an enormous number of personnel and resources. Medical training is complex and multi-faceted, and medical school administrators, faculty, and staff meticulously craft curricula to ensure that their students are prepared to be successful physicians.

At Vanderbilt University School of Medicine (VUSM), the pre-clinical curriculum relies heavily on small group learning. Three core components include case-based learning (CBL), faculty lectures, and anatomical dissection. The CBL curriculum is structured with groups of eight to nine students and a faculty facilitator. These small groups meet three times a week (for a total of 6 h per week) to investigate specific idealized patient cases and discuss the foundational sciences and clinical reasoning needed to understand each case. During the CBL discussions, students collaborate with one another to develop learning objectives and work through complex topics by utilizing direct conversation, images, videos, and handwritten diagrams. In the anatomy course, students are placed into groups of four to five for a cadaveric dissection in the gross anatomy laboratory. Expert faculty circulate to provide guidance and relevant clinical context. Additionally, prosection demonstrations are provided for students to compare their own dissections and visualize complex, difficult-to-see anatomy.
With the rapid spread of SARS-CoV-2 in the USA in late February and early March 2020, VUSM went from business-as-usual, in-person medical education one day to entirely virtual the next. Administrators, faculty, staff, and students worked feverishly to respond to the unforeseen and uncertain circumstances set before them [2–11] while trying to maintain high-quality education and the cohesiveness of the VUSM community. Within the first week of this dramatic change, we recognized that we all had an important role to play, students, and faculty alike, to make this new format successful. It was apparent that change would be a consistent theme throughout the pandemic and working together was a necessity — yet at a distance. A flexible and reliable way to navigate the large curricular and cultural shifts mandated by a safe response to the virus was needed. Among the many challenges to address was an acute need to effectively shift small group learning to an online format while maintaining the curricular integrity and atmosphere of collaborative engagement that is crucial to VUSM. Additionally, this global shift demanded a new strategy for anatomy and in-person lectures.

**Methods**

In setting out to find practical solutions for the pre-clinical curriculum, VUSM started with a few key baseline goals: (1) to empower students during an unpredictable time [7, 12–16]; (2) to identify and solve learning problems quickly; and (3) to combine student and faculty expertise together to forge a new learning culture based upon the strong.

To understand and meet these goals, a 12-member council, the Distance Learning Council (DLC), was created under the supervision of a faculty member. Members of the council consisted of pre-clinical student volunteers, representing each of the 12 different CBL groups (see above). Sessions were held via Zoom (Zoom Video Communications, San Jose, CA). At each session, the DLC explored problems and successes that students and faculty were experiencing due to the transition to virtual learning and generated potential new solutions. These sessions provided a supportive and open environment to discuss all problems faced. A representation of the role of the DLC is given in Fig. 1.

**Structure of DLC Sessions**

The goal of DLC sessions was to provide an open environment for problem and solution exploration in order to pivot successfully to online curricula while maintaining the core structure of VUSM and the key elements of strong group dynamics [17]. Sessions began with a collection of agenda items suggested by students, the faculty supervisor, and feedback gathered from the greater student body and faculty CBL facilitators. Feedback was collected through online surveys and verbal feedback at the end of CBL sessions. As each item on the agenda was discussed, students participated in divergent and convergent thinking to generate a set of possible solutions. Subsequently, ideal “next-step” solutions were selected and students volunteered to carry out these next steps. If the solution required involvement from VUSM faculty, students contacted faculty directly or asked the DLC faculty supervisor to reach out on the behalf of the DLC. During each meeting, there was also time dedicated to encouraging the group to reflect more broadly on how virtual education was going and how the students and faculty were coping with the challenges posed by the pandemic.

The primary role of the faculty supervisor was to provide structure to the sessions and to act as a VUSM faculty liaison. Specifically, the supervisor provided insights about available resources, faculty goals, and ongoing efforts to meet educational needs. Additionally, the supervisor helped moderate the DLC sessions and collected meeting minutes.

The frequency of DLC sessions was titrated to the needs of the students. Initially, sessions were held one to two times per week to allow for rapid iteration of solutions and to provide additional support for students [7, 12–14]. Subsequently, meetings were held as the need arose for council innovation (approximately biweekly). Follow-up and additional questions were addressed via email.

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Fig. 1 The parallel iteration model of the Distance Learning Council (DLC). Students on the DLC gathered feedback from their classmates and faculty facilitators regarding the rapid transition to virtual learning. The DLC generated proposals that could be implemented by faculty and generated resources for the student body directly. Frequent sessions of the DLC allowed for faster iteration.
Issues Addressed by the DLC

The abrupt transition from in-person education to a virtual Zoom-based learning environment demanded rapid adaptation to new circumstances [2–11]. A primary goal during this period was to continue to provide high-quality education and continued learning opportunities for pre-clinical medical students. To achieve this, the DLC wanted to facilitate the creation of an effective virtual classroom that ran smoothly, supported students, and allowed for discussion in a manner similar to that of in-person learning. The switch to virtual learning also posed a major challenge to anatomy, which required finding creative ways to replace hands-on 3D learning with online 2D learning [18, 19].

The major problems the DLC identified at the outset of the conversion to virtual learning were the following:

1. Many faculty and students were unfamiliar with Zoom and required assistance to navigate the virtual workspace effectively [9]. The majority of students and faculty had not used Zoom previously, and the DLC correctly anticipated that there would be technical difficulties in the beginning.

2. A new cultural “normal” needed to be set for virtual learning. Choosing and agreeing upon a set of norms for each small group are vital for communication and success in learning, and this issue did not evaporate along with the walls of the classroom. The DLC wanted to encourage groups to continue to develop strong teamwork skills and build community in this new environment [14].

3. The students no longer had a shared whiteboard. Students relied heavily upon this physical tool when class was held in-person and it was integral to our communication and collaborative learning in CBL.

4. Students had limited-to-no access to the traditional anatomy laboratory. Overall, the students and faculty became more aware of the learning benefits that come naturally from gathering together in-person, something that had previously taken for granted.

The DLC devised the following solutions for these problems to ease the curricular transition into a virtual setting. The DLC also predicted that unforeseen problems would continue to arise as students and faculty jumped into the uncharted territory of learning medicine remotely using a new format. The DLC remained eager to identify, understand, and address these challenges as required.

Solutions

Using Zoom as a Classroom

In order to improve familiarity with Zoom as quickly as possible, the DLC created a “Zoom Tip Sheet” for students and faculty. Several other institutes have similarly published tips for virtual medical education [20–22]. Our four-page document included technical instructions on using Zoom, general tips and etiquette, and additional suggestions for students and faculty. Examples of tips for students include enabling your webcam, using the raise hand feature, and determining a consistent order for reading cases aloud. Tips for faculty included providing feedback with the reactions, chat box, or nodding and setting the meeting time to allow group members to join early. The document was created by DLC students based on the feedback they had collected, reviewed by the faculty advisor, and then shared with the larger student body and associated faculty. The DLC also created a norming checklist to help groups to set expectations of one another in the virtual environment and figure out how group members could support one another. An example question was “How will you personally support your group members and classmates during this difficult time in the world?”.

Virtual Whiteboard

Prior to COVID-19, students relied heavily on a physical whiteboard to collaboratively draw diagrams, create charts, organize data and learning objectives, and discuss anatomy during CBL sessions. Due to the reliance on this core tool, the DLC sought out a virtual alternative that would allow multiple students to share visuals and edit them together in real-time. Members of the DLC researched options and came up with multiple possible options, including the Zoom whiteboard, Google Slides/Docs, Miro (Miro, San Francisco, CA), and multiple other software solutions. The DLC user tested each and solicited feedback from CBL groups after a week of exploration. The findings and opinions were compiled into a document so that it could easily be reviewed by all members of the DLC.

Although different virtual white boards provide a range of features and many would likely have accomplished our goals, the free educational version of Miro was chosen by the DLC. Some of the features of a virtual whiteboard include (1) the ease of use with a tablet stylus, (2) the ability for multiple users to simultaneously view and edit a document, (3) the availability of many templates and workflows, and (4) the ability to edit images, text, and shapes. To address the hurdle of adopting another new piece of technology quickly, the DLC created and circulated a 25-page Miro guide with examples and helpful step-by-step directions.

Virtual Anatomy

Students quickly recognized that a replacement for hands-on dissection and the anatomy-related physical exam skills laboratories would be difficult to duplicate on a 2D screen [18, 19]. This concern was brought to the DLC, who identified
multiple tools and resources. First, our council researched online anatomy tools and decided to propose a subscription to Acland’s Video of Human Anatomy (Wolters Kluwer Health, Philadelphia, PA) to the course faculty. Acland’s atlas was chosen because it includes video cadaveric specimens after dissection, providing a realistic simulation of anatomy lab, especially in showing 3D relationships between structures. Although this solution could not replace the personalized tactile experience in the anatomy lab, students reported that it greatly enhanced their learning.

The DLC also developed ways to increase student engagement with anatomy, which was previously provided by time spent together in teams side-by-side with faculty. With the suggestions from the DLC, our anatomy faculty created virtual “office hours” and breakout rooms to allow students time to ask individual questions in a structure reminiscent of our experience in the physical anatomy lab.

Reflecting the creative nature of our council and the difficulty students faced in learning anatomy, the DLC devised fun ways to learn anatomy which included an anatomy workout session and drawing on ourselves with body paint.

Our faculty was very receptive to our concerns about learning anatomy at a distance [18, 19]. The anatomy faculty wholeheartedly listened to our uneasiness and independently created interactive online modules using labeled cadaveric images. These modules were tailored to the material in our curriculum, included multiple anatomical donors to demonstrate the variability of structures, and were interactive, which allowed students to quiz themselves.

**Addressing the Cycle of New Problems**

With the evolution of the curriculum over the course of the year, students and faculty continued to discover new challenges along the way. Because the DLC met frequently, we were able to amend our recommendations document with solutions for problems as they arose. In addition, we continued to create additional new resources as needed.

One problem encountered later in the year was “Zoom fatigue,” which describes the increased exhaustion from spending long periods of time in the virtual learning environment. Together, we researched articles that included Zoom techniques, such as changing your view and turning off the camera “self-view” when it was professionally appropriate. In addition, we discussed this concern with our faculty leadership and worked to incorporate more small breaks throughout the day. Importantly, we created an environment for students to talk openly about their experiences learning at a distance to help one another realize that they were not alone in feeling Zoom fatigue.

Another problem that developed as time progressed was the increasing feeling of isolation [14]. Students were used to studying in groups in-person but did not have experience organizing and holding virtual study groups. In addition to generating ideas for co-learning, we made suggestions to help facilitate some of the impromptu conversations that may have happened organically in the medical school student lounge, where most medical students previously congregated. We continued to make space during every meeting to field new concerns from students and faculty and kept an “open door” inclusive policy for all of our meetings.

Thanks to our weekly meetings and live feedback from students and faculty, our group was able to monitor the implementation of our solutions including the Zoom Tip Sheet, digital whiteboard, and virtual anatomy modules. We feel based on our experiences and feedback from our peers that these solutions were successful in optimizing our virtual learning environment.

**Outcomes and Lessons Learned**

To address a need for rapid innovation in medical education [23–44], the DLC was a success and did not require additional financial resources. The DLC facilitated the transition to an effective virtual learning environment that responded to feedback from students and faculty in real-time. Through the DLC model, we adapted to changing student needs, provided support to our community, strengthened student–faculty relationships, and had fun! The response was rapid and well-executed: given little-to-no notice for the shift to remote learning, only 1 day of case-based learning was missed. Not only did the new model accomplish the same curricular goals as in-person CBL, but some online tools were seen as more effective than their in-person counterparts. For example, having an online, downloadable whiteboard lets groups save all work generated during CBL sessions for future reference. Miro was so effective that some students used Miro to study outside of CBL, and it continues to be used by students both for CBL and other learning activities. Furthermore, the chat feature on Zoom allowed facilitators to comment and advise the group with less interruption. The faculty found this tool to be increasingly helpful to privately coach students that were struggling and to provide on-the-spot positive feedback. These silent conversations allowed the flow of the discussion to continue to be student-led while maintaining a forum for facilitator contributions.

Feedback received from students and faculty members was positive. Maintaining an open line of communication allowed real-time response to pressing issues. The DLC also received positive feedback on our model when presenting to faculty members from institutions around the world at the International Association of Medical Science Educators “Cafe” series. Participants emphasized the ease and utility of implementing this type of system at their own institution.
Although feedback was overwhelmingly positive, several areas for future improvement have been identified. First, online surveys were not entirely successful. We distributed surveys to elicit feedback, but the student response was often minimal. We addressed this concern by having a representative from every CBL group on the council to make observations and listen to student comments and criticisms in real-time. Second, although a 5-min “Zoom break” between activities was requested, this was more difficult to put into practice than anticipated. The faculty leadership was receptive and supportive of this suggestion; however, there was no method of enforcement on a daily basis. Implementing a method to institute a culture of “mandatory” breaks could be used as a tool to improve student attention on days filled with multiple consecutive hours on Zoom. Finally, our efforts to improve anatomy were met with both praise and criticism. Overwhelmingly positive feedback was provided for the independent online modules created by our faculty anatomist, the expanded office hours, and access to Acland Anatomy. However, learning anatomy virtually is incomparable to the experiential learning that can come from the opportunities in an anatomy lab. Moving forward, additional efforts could be taken to increase the use of 3D anatomy applications and cross-sectional imaging to teach anatomy, expand opportunities for Zoom demonstrations, and allow limited access, when possible, to the anatomy lab that respects distancing policies.

At this time, in 2022, the curriculum at VUSM is entirely held in-person. As the transition away from distance learning occurred, the DLC was made inactive, yet the framework has been established and can be recreated if needed. The faculty–student partnership in educational efforts lives on through multiple other avenues at VUSM including the Curriculum Committee and Council of Class Officers which both have become more robust and have filled some of the gaps that were identified and addressed by the DLC. It is felt that the DLC, even if it becomes known by a different name (e.g., Learning Council (LC)), this same model can be reenacted seamlessly if there is a large shift in the curriculum. This LC could be used to enhance educational endeavors should the curriculum be forced to be virtual again or in the future if there is a considerable new curricular advancement brought to VUSM in-person education or during the clerkship years [43, 44].

Overall, the DLC was a success during the period of time when all learning was done virtually. The creation of a strong, solution-focused, respected, and creative student voice was exactly what our pre-clinical medical students and faculty needed. Allowing students to drive the conversation meant more student engagement and investment. This, in turn, led to improved educational outcomes. Though there were challenges along the way, our pre-clinical educational experience remained largely unscathed. This model is generalizable and scalable: it can be used at a moment’s notice should unforeseen circumstances arise and has the potential to be successful on a larger scale. This experience is in line with other studies that support the use of a model that shows that student involvement can lead to better educational outcomes [43, 44]. We encourage all medical schools to consider adopting this model, or something similar, as we continue to navigate the post-COVID educational world [18, 43–49].

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Declarations

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Consent to Participate NA

Conflict of Interest The authors declare no competing interests.

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