Engaging students with team-based learning in courses taught at two campuses synchronously: Two case studies in health sciences

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INTRODUCTION

The objective of this chapter is to assist faculty in effectively using team-based learning (TBL) in a synchronous virtual collaborative space. Two case studies highlight how courses are taught simultaneously in classrooms across partnering university campuses using the effective, evidence-based TBL method. In these case studies, the faculty member is physically present with students in their home classroom in a face-to-face setting, while a classroom of students from a distant partnering campus connects via two-way video. A presentation of challenges, approaches used, successes, failures, and lessons learned are presented through these “stories” from the trenches. Our first case will share communication challenges and solutions we encountered while connecting a face-to-face classroom to distance learners, then our second will discuss software solutions. Additional insights gained from lessons learned in our two locations/one-course experience were added to help readers who are adapting their TBL classrooms to a 100% online environment during the COVID-19 pandemic and beyond.

Best practices for online TBL are tied to the approaches used to address common difficulties encountered in development and presentation methods. Design, technology and faculty support are crucial for maintaining the four principles of TBL when teaching to a distant campus. Thus, topics related to challenges with technology, resource support, mentoring faculty, designing student activities when teaching at a distant site are discussed and...
integrated into the case studies. Online TBL best practices are tied to faculty activities necessary for successful course delivery.

US institutions of higher education face mounting economic pressures from rising costs, increased expectations, steadily shrinking state and federal support for public universities, and demand from the public to control the cost of tuition and student debt (Damon & Glewwe, 2011; Fischer, 2006; Jacob & Gokbel, 2018). In response, many institutions are finding creative new ways to share costs and resources through regional partnerships (Mattson & Link, 2019; WICHE, 2019). To control costs and the use of limited resources, some universities are considering multiple ways of delivering classes.

However, to ensure active collaborative learning, faculty must overcome many challenges to effectively engage students, especially those at the distant site. Flexible distant learning options became even more relevant after Spring 2020 when COVID-19 changed the way higher education is delivered in the United States, and perhaps worldwide.

Obstacles in promoting active learning with team-based learning

When using an online delivery method, many find it tempting to present course content through traditional lectures. However, evidence from educational research is overwhelming and unmistakable: active learning with student-oriented strategies provided by TBL (Michaelsen et al., 2004; Sibley et al., 2014) are more effective than traditional lecturing (Freeman et al., 2014). Despite such evidence, faculty are proving slow to embrace TBL to increase student engagement and participation in online virtual settings. There are several reasons for faculty resistance to change. Even in a face-to-face classroom setting, TBL is a complex methodology with a significant learning curve. Additionally, many faculty members have had little experience using active learning methods, some having never encountered this method as students. Faculty may shy away when their initial implementations of new methodologies prove awkward, while their students struggle to adapt to unfamiliar modes of learning, and the trial and error process of fine-tuning the course design and delivery proves daunting. Designing active learning methods is complicated, time-consuming, and challenging. Additionally, university faculty reward systems often do not prioritize support or training in TBL (Brownell & Tanner, 2012). This may discourage faculty from innovating to help learners. However, faculty support and mentorship (strategies used by the authors of this chapter) can mitigate these barriers to best practices and create successful outcomes in an online environment.

Recent TBL scholarship shows how active and collaborative learning can be implemented in online environments (Clark et al., 2017, 2018). When the TBL process (Sweet & Michaelsen, 2012) is integrated into online courses, it helps students prepare for participation in collaborative group/team learning. Individual and collaborative activities assure active learning and promote analysis and synthesis of the course material.

Challenges of the one course/two locations format

Recent advances in educational technologies make synchronous delivery of courses across multiple universities increasingly feasible. Institutional partnerships reported in this chapter require faculty to take on more students and accept the complexities involved with teaching at two sites. Some common problems include engaging students at the distant site, maintaining the TBL method’s integrity when using technology, creating a culture that includes both the distant and local sites, and using technology to support spontaneous discussion at both sites.
TBL was originally developed 40 years ago to teach business, but its use has expanded rapidly worldwide in health sciences education over the past 20 years because of its evidence-based record of improving problem solving and diagnostic skills as well as communication and team skills (Koles et al., 2010; Michaelsen et al., 2007; Parmelee et al., 2020).

This chapter uses two case studies involving five health science education courses over 18 years, highlighting challenges and solutions for teaching one TBL course at two locations. Case 1 highlights the needed resources to deliver TBL successfully; case 2 focuses on the use of an active learning platform (ALP) to maintain the integrity of TBL. In both case studies, the faculty members teach at two sites, face-to-face at their home campus, and via two-way video at a distant partnering campus. We share the challenges, successes, failures, and lessons learned while teaching at two sites, and integrate how we use technology to support TBL best practices in our discussion. The corresponding author currently trains faculty to use TBL via Zoom to teach students who are sheltering in place during the coronavirus crisis, and finds many of these best practices useful for doing so. It is our hope this article can help anyone considering using TBL for distant learning. Her recent observations of online TBL using Zoom have been added into the cases described below.

**STRATEGIES TO ADDRESS CHALLENGES OF THE ONE COURSE/TWO LOCATIONS FORMAT**

While the process for conducting TBL exercises is similar between face-to-face courses at one site and synchronous multi-site courses, the online format requires three crucial aspects, which will be presented individually and discussed in the two case studies:

a. additional student support to maintain engagement,

b. technological support to enable synchronous collaboration across multiple sites, and

c. instructional support for the teacher at both sites.

**Student support: Maintaining team engagement**

The distant site facilitator is crucial in keeping distant students engaged in the TBL activities (e.g., iRAT, tRAT, and application exercises), and each instructor can help that process. One strategy is to have the distant and local facilitators act in tandem. For example, the local site facilitator asks questions at regular intervals, and teams from the two sites are selected to answer questions in proportion to the ratio of the students at each site. The distant site facilitator can intervene to address technology problems or questions from students related to classroom issues. This assists in keeping TBL teaching activities moving at a reasonable pace to keep students engaged. In a 100% synchronous online environment, common during the COVID-19 pandemic, it is useful to have a technology support staff or co-instructor to watch the chat and manage the technology. Support staff can shift students to breakout rooms, mute and unmute participants, and help students whose connections drop and are reconnecting, and so forth, so the primary instructor can fully focus on facilitating the TBL session.

Traditional TBL does not call for team roles. However, for online TBL, it is important that each team must choose a speaker for each activity. Therefore, when a team is called on, this reduces delays (e.g., team members deciding who will answer, fumbling with microphones). In an online setting, 10 seconds of dead air seems like an eternity to the opposite site, and students quickly lose interest in the exercise. Teaching students to use structured call/response guidelines avoids this problem.
It can be helpful to have the facilitators listen in on team progress while students are discussing questions to determine when learners are ready for the class discussion phase. This can be accomplished at the face-to-face site by walking around the room, or, while using technologies such as Zoom, switching between different team breakout rooms.

When teaching on two campuses, students at the distant site typically feel they are learning at a disadvantage. At least once per semester, ideally during the first session, we recommend the instructor travel to and direct the TBL class from the distant site. In the primary author’s experience, the distant site students appreciated faculty coming to facilitate TBL classes in person, and it seemed to help the distant students feel as though they were as important as the local face-to-face students. During this initial visit, the corresponding author divided the remote site students into diverse teams and gave them the advantage of a course “sneak preview” before doing so with the local site counterparts. Students at both sites seemed to better relax and get into the spirit of the course when they knew what to expect. Orientation of the entire class should occur the first week (see Clark et al. (2021, this volume) for more information) with exercises depicting the advantages and pitfalls of small group learning. These exercises can clarify how TBL’s various strategies are designed to maximize the pros and minimize the cons of small group instruction. Once the course starts, we found it helpful to hold periodic optional teleconferences for the remote site students for feedback and to address concerns (Sibley et al., 2014). If feasible, we suggest that 100% online instructors offer “student hours” for one-on-one meetings to help individual learners.

**Technology support: Audiovisual technology**

Our experiences during the coronavirus pandemic have underscored how crucial technology is for online communication (strong wifi, good mics, webcams, etc.). Even more-so, high-quality audiovisual (AV) technology is essential for successful TBL in a two-site synchronous distance education format—particularly clear, interference-free sound. In order for the students to come together as one class teams need to hear each other and report clearly between the campuses, without distortion or extra noise. In our case studies, participating universities renovated classrooms, upgraded wifi, and installed two large screens for dual projection. One screen displayed the teams at the distant site, and the other alternated between PowerPoint slides and the case-based computer system using a screen sharing program. Cameras should be able to view both the instructors and the students at both sites, and microphones should be available for every student at both sites. Again, we underscore, sound is particularly important for successful distant TBL learning. Ideally, each student should have a push-to-talk microphone and cameras that can switch between the instructor and students depending on who controls the microphone at either the local site or distant site. In the days of COVID where students are at home using online meeting software, each has their own microphone and camera, and each team has their own breakout room, sound contamination is less of an issue.

A good working relationship with the AV support group is essential for active management of the AV system at a level needed for face-to-face and distance TBL. Communication and coordination of the AV support groups between campuses are also critical for diagnosing and correcting problems quickly. The AV support personnel need to understand the TBL process so that they can provide the requirements of the classroom to optimize TBL discussions. In our case studies, one university invested in microphones with push buttons to talk for each desk, the other university purchased cost-saving ceiling microphones at the home site and portable wireless microphones for the distant site teams. In practice, the ceiling mics transmitted student voices during team discussions. However, they also...
transmitted the crackle of every candy wrapper, clicking keyboard, sneeze, and side conversation. The technology assistant turned off the mics during times when the sound transmission was unnecessary, such as during tests and intra-team discussions, and turned them back on for whole-class activities, to help address this problem. If possible, push-to-talk desk mics for each student are preferable to ceiling or handheld mics. Students frequently fumbled with turning on portable mics, causing delays that interrupted the flow of the discussions. The portable mics also needed constant attention, fresh batteries, and repair. If portable mics are used, spare microphones should be purchased to swap out when needed during class sessions. Such attention to working technology helps assure that facilitators can maintain a quick pace and keep interactivity high. These specific practices in procuring and maintaining technology are in line with best practices for online learning.

**Instructor support at both sites**

Staff and faculty support for preclass, in-class, and postclass activities is crucial for distant sites. For example, a course facilitator is needed at the distant site to prepare folders with RAT questions and application exercises (as well as items like bubble sheets and IF-AT forms, if used). Following the TBL exercise, the distant site course facilitator can grade iRATs and tRATs, score and share application exercise answers with the facilitator at the local site.

Quickly reporting and resolving any AV or communication problems for the distant learners is crucial. We found it beneficial to exchange cell phone numbers between facilitators so they can communicate with each other without disrupting the learners. Good joint-facilitation helps keep the distant site engaged in the TBL strategies. The distant site facilitator can answer student questions during breaks, engage with students, and relay information back to the local site during TBL exercises. Similarly, we have found quick, private communication between the faculty facilitator and the technology support staff or co-teacher in 100% synchronous online environments is essential to keep TBL running smoothly.

In two-site classrooms, it’s possible to have good local technology support, whereas in 100% synchronous online courses taught via conferencing software, students are on their own when technology fails. Even with good local support, the internet will go down, the LMS will malfunction, and student computers will crash, disrupting the class’s flow and integrity, which wreaks havoc on distant learners who may be struggling with individual technology issues. In our experience, the presence of technical support teams at each site to repair the room technology and having “loaner laptops” on hand for student use, helped control variables of local site technology.

In face-to-face courses, faculty are accustomed to improvising when technology fails. However, when the technology does not work in two-site synchronous courses, and the distant site is completely dependent on it, the class grinds to a halt. It was vital to have backup plans such as recorded sessions (lecture capture) so that the distant site can catch up if there is a disruption. Even with a backup plan, it can be difficult to continue class when the technology fails. In well-designed TBL classrooms, students become increasingly bonded to each other, and they worry about each other when the connection is severed to the distant site, causing the focus on learning to waiver.

In both two-site and 100% asynchronous distance courses, facilitators should have backup plans in place for those students who suffer insurmountable technology issues during a session. Recorded lectures and interactive worksheets that simulate the team application exercise experience can help individual learners suffering a technology fail, but also operate as a backup plan if the distant site technology fails during the learning session.
Technology solutions for IRATS, TRATS, and application exercises are presented in the second case study.

CASE STUDY 1: APPLYING TBL IN A TWO-SITE, SYNCHRONOUS COURSE

Motivation and background

The following case study gives examples of how the above suggestions were integrated into two two-site courses taught across one distant and one local site. The approach presented was developed through two significant teaching obligations: (1) teaching physiology, pathophysiology, pharmacology to the pharmacy, dentistry, and the physicians’ associate students across two campuses from 2002–2019 and (2) teaching clinical pathology to 145 veterinary students across two campuses from 2009–2011. In the first teaching effort, the instructor began using TBL in the spring of 2002 because of an instructional need to apply and integrate concepts using case studies in a Human Physiology class in the College of Pharmacy, Dentistry, and the Physicians Associate Program at the University of Oklahoma Health Sciences Center in Oklahoma City. The College of Pharmacy expanded its program from 200 students to the University of Oklahoma Health Sciences Center (OUHSC) in Oklahoma City by adding 30 students on the OU Schusterman campus in Tulsa. In 2010, clinical cases and TBL were added to the OU College of Medicine preclinical courses, and in 2015 these teaching strategies were incorporated into the College of Medicine when they expanded the preclinical curriculum to Tulsa. The College of Pharmacy was very supportive of the class and the TBL method and invested heavily in technology and staffing to make the method a success. The second teaching effort began in 2008 when Iowa State University College of Veterinary Medicine (ISU CVM) and the University of Nebraska at Lincoln (UNL) established a cooperative agreement to create a “2+2 program.” According to this agreement, UNL veterinary students attend the first 2 years of the professional program at the Lincoln campus and then transfer to the ISU CVM campus in Ames, Iowa, to join their ISU classmates to complete the final 2 years. However, UNL was missing a faculty clinical pathologist to teach the core 4-credit clinical pathology course scheduled during the second semester of year two. The faculty at ISU CVM decided to teach the clinical pathology course to the 24 UNL veterinary students from a distance in addition to 121 veterinary students at ISU. After 6 years of successful implementation of a one course/two locations format, the OUHSC instructor mentored the ISU instructor to implement a similar format.

Class overview with the integration of team-based learning in both courses

For both courses, the instructors taught using TBL. The decision was made to accept the challenge of adding more students to the class from a distance while retaining the TBL methodology. Thus, the faculty were committed to maintaining an online course for the distant site that supported the four essential TBL principles. Faculty members who taught the courses presented here had extensive experience in TBL. The outcomes from this teaching modality demonstrated unprecedented student excitement, engagement in learning, a connection between classmates, and excellent learning outcomes consistent with those well documented in the literature (Michaelsen et al., 2014; River et al., 2016). The
goal of bringing TBL to this distributed, synchronous teaching model was to create conditions so teams of students in both locations could build camaraderie as if they all were in the same room, typical of the face-to-face classroom. Online TBL best practices require the instructor to consider the delivery method when creating the course so that some initial course time is spent on team building and communication activities. These activities are crucial for online students’ motivation and success.

The courses were designed as follows. TBL exercises were based on case presentations to apply and integrate course concepts. The overarching course goals for the veterinary clinical pathology course were for students to learn how to interpret laboratory data using a sound diagnostic process by applying pathophysiologic principles of disease. The course was built upon a series of over 100 cases of increasing complexity illustrating common abnormalities of the various body systems in domestic animal species. The human medical courses’ overarching goals were to apply and integrate concepts in physiology, pathophysiology and pharmacology.

Because these courses were taught synchronously at two different sites, the launching of TBL was similar to face to face learning. However, there are some significant differences in technology and needed resources to facilitate seamless instruction at the two sites. A variety of best practices for Online TBL is integrated into this class format.

Implementing TBL

The following descriptions describe the challenges and successes of implementing TBL in the two courses taught simultaneously at two different sites. We explain below how the course was designed to meet the learning needs of students while maintaining the four essential principles of TBL.

Preclass Preparation

Veterinary students prepared for each module by reading a chapter in the textbook and working through the diagnostic rationale of clinical cases using the open-source computer program ThinkSpace, (Bender & Danielson, 2011) at a pace of about six cases per week. Because the ISU College of Veterinary Medicine has a traditional lecture-based culture and homework assignments outpaced their other classes, eliminating lectures was not an option. However, lectures were reduced to about one-third of the class sessions, leaving two-thirds for application exercises.

Modified readiness assurance tests

Technology allowed the class members at both sites to view each other. Seeing each other was important for class members at both sites to develop trust and cohesion. The lectures were interactive to ensure both sites interacted. Every 10 min, the veterinary lecture was paused for clicker questions that served as modified tRATs. The clicker questions were embedded in PowerPoint presentations. At both sites, each team was issued one clicker to input their answers when signaled for a simultaneous response.

Transmitting the answers of the tRAT so that both locations could view teams’ item responses was challenging. Though the local class could transmit the clicker questions and responses using shared screens to the distant site, this did not work in reverse. Instead, one
student on each team logged into an online audience response system to send responses from the distant site to the local site. Happily, the team numbers, both local and distant, showed up on the screen instantaneously when teams entered their selections. Although teams were given ample time to discuss their responses before they clicked in, the display served as subtle peer pressure for teams to respond in a timely manner. It also served as a signal to start the whole-class discussion once all teams answered.

An environment was created that allowed class members at both sites to participate equally in class discussions. A numbered ball was drawn out of a jar to select the first team of veterinary students to defend their answer to the entire class, and then teams who disagreed were invited to convince the other teams of their rationale. The answers were not revealed in order to encourage productive discussions, and teams were asked to build the key together in real-time. Often, the instructor would play “devil’s advocate” to deepen their understanding. The goal was to create a classroom with students from both sites to feel safe but also have a stimulating fast-paced exchange. If a veterinary student could not adequately explain a response, they were encouraged to “phone a friend” by calling on another team. They often chose a team at the other site, which then turned into a fun and playful exchange. Students learned valuable communication skills during spirited inter-team debates. This process uncovered misconceptions and deepened student understanding of the underlying pathophysiology. Veterinary students often commented that this sort of interchange made the distance seem to disappear, and class time fly by quickly.

Application exercises

In the pathology course, two-thirds of the simultaneous class sessions were devoted to in-class TBL application exercises. Clinical cases were a natural fit for application exercises because they were complex and nuanced enough to engender lively team and whole-class discussions while surfacing more previously held misconceptions and further deepening understanding of diseases. Assuring that both sites had access to the same technology was essential. Both sites had two clinical cases assigned as homework on ThinkSpace before each application exercise. Homework cases were low stakes assignments, where students practiced their diagnostic skills on relevant clinical cases. Students were awarded course credit for submitting their diagnostic rationale before class and were not punished for incorrect answers. After submission, the program provided immediate and detailed expert feedback for comparison alongside their diagnostic rationale.

Each class began by projecting to the two different sites the two detailed clinical case solutions from the previous night’s homework and questions from the class. After a short discussion, students from both sites worked individually on a third clinical case with similar pathophysiology to one of the two homework cases, but with a different case scenario, species, and laboratory data. The application exercise drilled deeply into their understanding of the pathophysiology of each case. Students first answered the questions individually, submitting their answers on the learning management system (LMS) using their laptop computers. Once everyone submitted their answers, teams answered those same questions as a team, debating their answers, convincing each other of their rationale, and then submitting their collective team’s answers on the LMS. Once all teams submitted their answers, a lively class discussion that included both sites followed, using a similar format as the tRATs.

The course credit for working through and submitting the preliminary application exercise homework assured student accountability for preclass preparation. The individual application exercise helped students contribute meaningfully in team application
exercises and whole-class discussions. Because the cases were complex and students had prepared as homework before class, during lecture tRATs, and their individual responses, these application exercise debates were even more lively, nuanced, and engaging than the tRATs. Students later commented that this exchange helped them get to know the students at the other site and helped the class gel once the UNL students moved to Ames in their third year.

Evaluation

Despite challenges during the first year of implementation the clinical pathology course in two locations, student evaluations were encouraging. During the first year of implementation, the mean overall assessment of the course was 1.60 (SD = 0.73 with 142/145 students reporting), where 1 = very good and 5 = poor. There were no significant differences between sites on comprehensive case-based final examination scores. There were significant differences between sites on the end of course, student evaluations in six of 17 responses. Student satisfaction data was positive. Course evaluations had 17 additional categories of responses including course organization, grading, effectiveness of lectures, and software. To our surprise, in all cases of significant differences, UNL (the distant site) demonstrated higher satisfaction. The majority of student answers to open ended questions concerned the value of getting to know their distant classmates prior to when they moved to Ames in their junior year. Examples included:

• I thought that it created a great dynamic environment that made the UNL students actually feel like they were part of the class!! It was great way to prepare us for our interactions next year.
• It was good to see our classmates. I think it will help us next year when we are working together.
• It felt like we (at UNL) were more a part of the class than in other classes in the past. I think it will help with the transition.
• I think it’s great for our classes to interact together prior to the UNL students coming to Iowa State. It gives us a chance to work together as colleagues.

Students were asked, "In the future, should Iowa State University students and the University of Nebraska Lincoln be in Clinical Pathology simultaneously?” Responses showed that 82% of the local site and 78% of the distant site answered yes. There were no significant differences between sites on this question.

CASE STUDY 2: UTILIZATION OF AN ACTIVE LEARNING PLATFORM

Motivation and background

In 2012, the third author took over the clinical pathology course from case study 1 for 147 veterinary students across two campuses, with less technological support. This presented numerous challenges in maintaining TBL’s essential principles in an online environment. The new instructor redesigned the course to rely more heavily on technology to meet the course’s TBL activities because she did not have access to an onsite TA or designated instructional support staff member. A course facilitator familiar with the course discipline at the distant site helped this course succeed. While an IT team was available at
the local site, they had many additional responsibilities that prevented them from a routine and lengthy presence in the classroom. Because of these specific circumstances, the course needed to be independently facilitated. The use of an active learning platform (ALP) to moderate the group activities became the best solution for the course and allowed the instructor to operate as independently as possible. ALPs are educational technology platforms that heavily incorporate active learning tools such as polling and real-time student responses for activities such as think, pair, share into their structure to facilitate student engagement. These activities can be interspersed with more traditional didactic teaching materials on the platform to facilitate a seamless delivery. Additionally, all polls and student responses can be made available for students to access and review at a later date (Duffy et al., 2017).

The ALP was used for all group work within the course, including the tRAT, and to enhance student engagement during lectures. This technology was crucial to maintain best practices for TBL learning activities, including the iRAT, tRAT, appeals, application exercises, and peer review.

**Application exercises on an active learning platform**

The ALP was an efficient, helpful, and easy way to facilitate the group application exercises for larger classes and those with distance learners (Herbert et al., 2017). Relevant materials for the exercise were stored on the platform in advance and were readily uploaded as a PowerPoint file; this eliminates the need to print and hand out documents for the activity. The organized learning activities and discussion points were created within the platform and are easily interspersed between the uploaded materials in the most logical location for groups to progress through the exercise and are accessible to students as well as the instructor. The application portion of the modules was established in a clinical case bank on the ALP (originally LectureTools ALP) by Echo360, now transferred to TopHat) in 2015.

Clinical data were collected from patients, including history, patient characteristics presenting problem(s), and laboratory data, were incorporated into the learning platform and directed questions and activities were created to guide group discussion and learning. The instructor was able to release additional data to the students when they were ready for more information. Furthermore, real-time feedback regarding the lab data or images were collected (e.g., students identify specific cells on a peripheral blood smear image) to assess student engagement and comprehension. The cases were designed to present patient data (history, physical exam findings, laboratory data, etc.) in real-time for interpretation. The students were allowed to select (via simple majority) which diagnostic test they were most likely to perform next ("choose your own adventure" style) to mimic an authentic clinical setting more closely. Separate practice cases were also made available for independent study.

Student feedback regarding the interactive case bank on the ALP was enthusiastically positive, and course comments from the learners at the distant site suggested an improved feeling of connection with both the course and their local site colleagues. This was especially important since the distant cohort was smaller (~25 students) than the in-person cohort (~120 students). Learning outcomes were also improved following this course change, as evidenced by significantly improved overall student performance on the final exam following use of the ALP case bank for the application exercises, as illustrated in Figure 1. The active learning platform was used to facilitate the application exercises, which were in the form of clinical cases, beginning in 2015. This change was associated with a significant improvement in student performance as evidenced by higher final examination.
FIGURE 1  Comparison of final examination scores in Veterinary Pathology 425, Clinical Pathology

scores in the course ($p < 0.05$, Kruskal–Wallis multiple-comparison $Z$-value test with Bonferroni correction).

**tRATs on an active learning platform**

The ALP was advantageous as a mechanism to deliver the tRAT for several reasons. First, the instructor could instantly assess class performance on the question once all groups have answered to determine if further discussion between groups was needed. Second, the Team answers for both the tRAT and application exercises were permanently recorded on the platform for transfer to the grade book at the instructor's convenience. This was a more streamlined process than either visualizing team choices via raised answer cards for the application exercises or collecting a physical recording of a group answer choice on paper, especially when it was a larger classroom and/or a distant campus was involved. Third, there were multiple options for the type of assurance activity inherent in the platform design, giving great flexibility in the design of the exercise. Finally, the instructor could decide whether to release a particular tRAT to allow students to review the material at any point in the semester with a few simple steps. Logistically, it was simpler to set up a separate “course” in the ALP solely for the administration of the tRAT. Each team was given a unique login ID for the course, which they used to record their answers for the weekly tRAT. This was easier to manage than having a designated student from each Team login to the ALP with their personal ID. It also provided a distinct separation between the application exercise and tRAT content on the ALP.

**Selection of an active learning platform**

The unique demands of this course (use of TBL in a synchronous, distant site) necessitated a flexible, reliable, and user-friendly ALP that could readily display written feedback
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FIGURE 2  Screenshot to demonstrate how the active learning platform (TopHat) was used to moderate TBL in this course. Case data, as well as group discussion and interpretation activities, were released in real-time as teams worked through the case.

from participating teams to both the instructor and students as a whole. The platform also needed to be readily accessible to the students at each site. Platforms such as TopHat can be easily accessed remotely and will instantly display group responses to all students once released by the instructor. There were multiple options for interactive and assessment slides, including open discussion (all groups can visualize other group answers in real-time as they are uploaded), short explanation, long answer, multiple-choice, and "click on target" for images.

For the group application activities, a combination of these choices was used throughout each case to facilitate group learning and class discussion. Keeping the local and distant site students engaged in the class activities and with each other presented unique challenges. Presenting the material in real-time as groups work through the case allowed the instructor to pace the progression for both locations in an organized and temporal manner that more closely mimics how veterinarians work up patients in an actual clinical setting. This was particularly important for the students at the distant site. Additionally, this real-time feature helped prevent students from getting distracted by having all of the case data at once. The platform was also extremely helpful for generating class discussion between the teams. For example, a favorite feature was the "long-answer" question format. By using this feature, teams could work through a problem within their group, and then when finished, have them record their team number and response on the platform. When the groups were all done, the responses could be released for all students to view. The facilitator could then prompt discussion between the teams by asking a team to relay their thought process to the rest of the class, and so forth. This format also helped hold all teams accountable for their work, even if not every team was called upon to discuss their answer. Team responses were never during the application exercises for grading purposes, but rather only to facilitate class discussion, as students were reminded repeatedly throughout the semester. An example of how this feature works in TopHat is given in Figure 2. Team responses were recorded within the platform and utilized by the instructor to help generate discussion between the teams. Once the teams had completed the application exercise, all of the case content, including all group questions, answers, and discussions, was released for review on TopHat for students to refer to as needed. Additional cases could also be posted to the platform for students to work independently outside of class.
Audiovisual technology and IT support

As covered in more detail in the previous sections of this chapter, excellent audio and visual communication between the two campuses was paramount to the success of a course with multiple campuses. Students at each site will quickly become disengaged if there are significant interruptions to either the audio or visual feeds between the two locations. A talented and creative IT support team was necessary to help get the course started and should be available for consultation if emergencies occur during the semester. One helpful tool is an audience Catchbox throwable microphone, which is passed between groups in a large classroom setting to allow easy microphone access to members of a broad audience. Zoom was used to connect audio, visual, and content streams between the two campuses; this worked very well, and it was easy for an IT layperson to set up the connections successfully. Finally, it was beneficial to convey a second, separate content stream to the distant campus during the tRAT and case application exercises. This content stream allowed the display of both the case data, as well as the question/group activity, prompts simultaneously to both audiences. The IT requirements for this were a bit more involved, requiring two monitors capable of displaying different content at each location. This can be done by establishing two separate Zoom connections between the sites: one connecting the classroom desktop and the other connecting to the instructor’s laptop. Rarely, there were issues establishing one of the connections at the remote site. This usually resulted from an issue with one of the remote desktops failing to connect Zoom. In these cases, an IT team member was called to the classroom to try and resolve the issue. The instructor was mindful of these delays and would typically switch to an activity that could be facilitated with one content stream if the issue could not be resolved promptly. The utilization of two content streams is by no means necessary for using TBL to engage distance learners. Still, it was helpful for both the facilitator and the learners during the application exercises.

RECOMMENDATIONS AND LESSONS LEARNED

Students can be engaged successfully using TBL in courses taught synchronously at two campuses under the right conditions. Small details often make or break a TBL exercise, especially when involving a distant site. The top ten take-a-ways to set up for success are:

1. Provide comprehensive student orientation to TBL, paying extra attention to those at the distant site, so they feel included.
2. Mentor faculty colleagues who are unfamiliar with TBL to maximize facilitation skills.
3. Redesign the course to maximize student accountability and student interaction keeping in mind the interaction within teams and between teams and sites.
4. Design TBL exercises that engender lively team and whole-class discussions that deepen understanding while surfacing misconceptions.
5. Provide many chances for individuals and teams to make decisions, with rapid and appropriate feedback.
6. Create a classroom atmosphere that feels safe to students but at the same time, has a stimulating fast-paced exchange.
7. Invest in technology so that teams at near and distant sites can hear and see each other during discussions, helping the distance disappear.
8. Invest in a talented technical support team that supports both sites.
9. Find flexible and reliable technology that works your specific course’s needs and use it to your advantage.
10. Create backup plans for when technology fails.
CONCLUSION

With the explosion of available information, well-designed and engaging education has never been more important in health education. The evidence of the superiority of active learning strategies such as TBL is incontrovertible. A 40-year track record of research and implementation of TBL in higher education and 20 years in medical education demonstrates its success.

We are in times of unprecedented societal change worldwide. The US higher education system suffered from growing financial constraints before COVID-19, which has escalated rapidly as the pandemic spread. This placed tremendous demands for faculty worldwide to change their teaching modalities, bringing face-to-face courses online almost instantly.

As COVID began inflicting its hardships, the authors witnessed an outpouring of resource exchange between institutions. Faculty shared their ideas about teaching methods and the creative use of technology to support online learning. For the authors, lessons learned from successful face-to-face TBL design and implementation informed best practices in our two locations/one-course experience, which, in turn, were shared to inform our synchronous fully online format.

After the pandemic, we look forward to taking lessons learned with TBL online back to the face-to-face classroom, giving us options that we never considered previously. We found that we don’t need to compromise learning, whether teaching face-to-face, partially or fully online.

ACKNOWLEDGMENTS

The authors wish to acknowledge Karen Bovenmyer for help in manuscript editing, as well as Dr. Elisa Salas, Dr. Sarah Sillman, Dr. Matt Hille, and Roxanne Ellis for their invaluable help in UNL classroom management and Lisa Gestrine, Deb Hoyt, Paul Mangiamele and Christina Boysen for their important contributions to the ISU classroom technology.

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**How to cite this article:** Bender, H. S., Garrett, K. M., & Hostetter, S. J. (2021). Engaging students with team-based learning in courses taught at two campuses synchronously: Two case studies in health sciences. *New Directions for Teaching and Learning, 2021*, 107–121. https://doi.org/10.1002/tl.20440