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Three Steps to Adapt Case Studies for Synchronous and Asynchronous Online Learning†

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Pandemic SARS-CoV-2 has ushered in a renewed interest in science along with rapid changes to educational modalities. While technology provides a variety of ways to convey learning resources, the incorporation of alternate modalities can be intimidating for those designing curricula. We propose strategies to permit rapid adaptation of curricula to achieve learning in synchronous, asynchronous, or hybrid learning environments. Case studies are a way to engage students in realistic scenarios that contextualize concepts and highlight applications in the life sciences. While case studies are commonly available and adaptable to course goals, the practical considerations of how to deliver and assess cases in online and blended environments can instill panic. Here we review existing resources and our collective experiences creating, adapting, and assessing case materials across different modalities. We discuss the benefits of using case studies and provide tips for implementation. Further, we describe functional examples of a three-step process to prepare cases with defined outcomes for individual student preparation, collaborative learning, and individual student synthesis to create an inclusive learning experience, whether in a traditional or remote learning environment.

INTRODUCTION

Case studies come in many forms but typically have a narrative to engage students and bring course content to life through storytelling (1). They encourage active learning, peer interactions, and critical thinking (2). Case studies can be used in various teaching modalities, including online synchronous or asynchronous lectures and labs. Many cases are available for face-to-face instruction (Appendix 1, Table S1); here we outline best practices (3, 4) for adapting cases for the online classroom, with examples from our own teaching.

PROCEDURE

Case studies are often modified prior to implementation. Here we provide ideas for adapting cases for online teaching with a three-step implementation approach: individual student preparation, collaborative learning, and individual student synthesis (Fig. 1). We also use examples from our experiences teaching case studies online, focusing on a case implemented with 120 students imagining themselves as researchers conducting epileptic drug discovery research. Students use the Allen Cell Types Database (https://celltypes.brain-map.org/), analyzing data on temporal lobe neuron excitability and how cells in this seizure-prone area may be distinct from other brain regions (contact SR for case access).

Step 1: Individual student preparation

Individual student preparation is paramount across modalities. With online case teaching, we recommend a flipped approach in which students independently examine
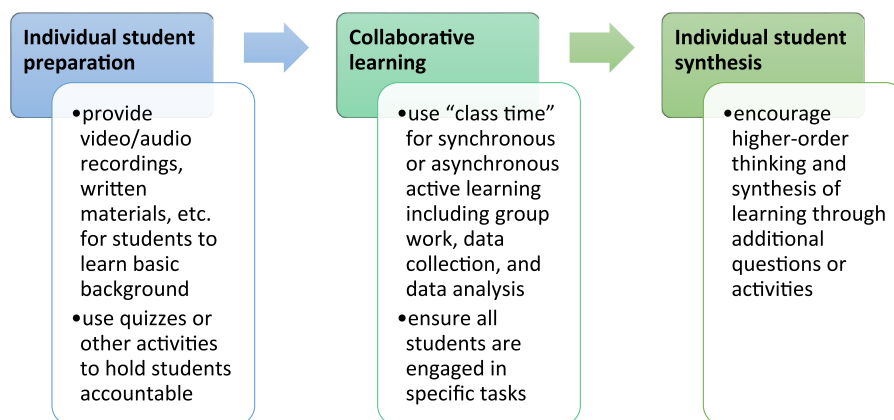
FIG 1. Three-step implementation framework for integrating case studies in the distance learning classroom.

key background information asynchronously before engaging in active learning with peers (http://rtalbert.org/how-to-define-flipped-learning/) (5, 6). Guidelines and examples for delivering flipped cases using videos are available from the National Center for Case Study Teaching in Science (7) and include the suggestion that videos be used to set the scene (introduce the story), as well as to present content. Table S2 (Appendix 1) highlights resources for creating or finding videos. Brame (8) provides information on producing effective videos, including reducing cognitive load, increasing student engagement, and promoting active learning (e.g., keep videos short and focused, use both verbal and visual cues, incorporate videos into assignments). Logistical details such as planning the video, video production tools and copyright are emphasized in Prud'homme-Généreux et al. (6).

If videos are not your style and/or students have limited bandwidth, provide documents (Word or PowerPoint) within the Learning Management System (LMS) for each part or step of the case. Adding graded questions is essential to make learning more active and demonstrates your expectation that students engage with the materials. These assignments provide a common framework for students before class and low-stakes formative assessment of learning to help faculty screen for common misconceptions ("Just-in-Time Teaching"; https://serc.carleton.edu/introgeo/justintime/index.html). For instance, within the epilepsy case study, students read a neuroscience text excerpt, watched a video, and answered questions as they explored the Allen Cell Types database. The instructors then reviewed student comprehension and addressed misconceptions during the synchronous session.

Step 2: Collaborative learning replaces face-to-face class and labs

The next step is the online collaborative experience. Be prepared for students who cannot participate synchronously. Have asynchronous alternatives ready and/or record synchronous sessions (https://www.idra.org/resource-center/ensuring-equity-in-online-learning-newsletter-article/). Whether students meet synchronously or asynchronously, we find small group work to be particularly beneficial. The expectation is that students will interact, share information, and challenge each other's ideas (Appendix 1, Table S3) (9). Research suggests outcomes are improved with demographically heterogeneous groups (10). However, if groups meet asynchronously, it may be best to let students choose teams based on availability (Y. Lin, personal communication). Group work might include discussion questions or other active learning such as jigsaws, gallery walks, or collaborative concept mapping (11–13; https://serc.carleton.edu/introgeo/gallerywalk/what.html). Another option is data collection and analysis, which is a core biology competency (14) and essential for remote lab instruction. All of these can be adjusted for synchronous or asynchronous online learning with the appropriate collaborative technology (Appendix 1, Table S3).

It is important to engage all students in group work. One technique is to assign each student a specific role in the group; this improves individual learning (15). Roles could align to POGIL (Manager, Recorder, Spokesperson, and Reflector; https://ctl.wustl.edu/resources/using-roles-in-group-work/). In an asynchronous course, one colleague assigns students to be the Point Person, Weekly Summarizer, and Explorer, the last of whom discovers and shares related information from a source other than those provided (L. Rettenmeier, submitted for publication). Note that in asynchronous discussions, setting deadlines for initial sharing and for later wrap-up is necessary so students can respond to peers in a timely fashion.

Faculty-student conversation during breakout sessions can help identify confusing concepts. These can be addressed by sending a chat message to the whole class. Teaching assistants can assist with this in large classes. Written work could also increase engagement but is not a substitute for faculty-student interaction that prods students toward higher-level thinking. Polling can be used for a quick assessment of comprehension through multiple-choice or short-answer questions, such as "type one word to describe the most important thing you learned about X."

For the epilepsy case, students were assigned to Zoom

breakout rooms to collect data and share it via a collaborative class Google document. Individual roles were not assigned during data collection, but each student was expected to contribute data from a specified number of neurons. The data analysis portion could have benefited from assigned roles, for example, a Recorder to maintain a chronology of data input and findings, an Explorer to perform the data analysis, and a Statistician to manage statistical tools and interpretations. Data collection and analysis may present challenges for large classes as greater numbers of student groups require additional faculty oversight. A parallel online forum (Piazza) allowed students to post questions and get answers from instructors and other students.

Step 3: Individual student synthesis

After the collaborative learning, hold students accountable with individual work (3, 4) in which they apply knowledge in new ways. For instance, students may use newly learned concepts and apply them to a novel scenario, propose additional experiments, or extend the same approach to a new story or data set. Students could also reflect on how the case relates broadly to science and the community (16). These tasks encourage higher-order skills (17). Ideally, students should submit individual short answers graded for correctness, but this might prove difficult in large classes. Alternatives include polling to assess understanding, work submitted by groups, or individual quizzes administered within the LMS (4). Appendix 2 provides additional suggestions for summative assessment and comments on technology issues. While the epilepsy study required group submissions of the entire case once completed, other cases that we have implemented have incorporated a variety of options to assess the learning goals.

Federal guidelines suggest two to 3 h of student work for every hour in class (18). Online case study teaching can follow these guidelines with two to 3 h combined preparation and follow-up for each synchronous hour (and the equivalent summed hours for asynchronous online teaching). The epilepsy case involved 1 h of independent, asynchronous preparation, 1 h of synchronous group work with the professor present, and 1 h of asynchronous group work to wrap up.

CONCLUSION

Our classrooms may look different in the era of physical distancing and stressed bandwidth, but we can still enhance student learning and reinforce course content using case studies. By following the three-step approach (Fig. 1), we encourage students to progress from lower to higher levels within Bloom's taxonomy of learning and also provide multiple assessment opportunities. Students (i) achieve foundational knowledge through individual student preparation (remember and understand); (ii) tackle activities collaboratively following specific roles and responsibilities (understand, apply, analyze); and (iii) synthesize new conceptual understanding (analyze, evaluate, create). Together, these tips and resources provide a framework for the use of case studies to promote active student learning through both individual and group work regardless of course modality.

SUPPLEMENTAL MATERIALS

Appendix 1: Additional resources
Appendix 2: Summative assessment and technology issues

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