



Supplemental Materials

for

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

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Table of Contents

(Total pages 7)

Appendix 1: Additional resources

Appendix 2: Summative assessment and technology issues

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Received: 29 September 2020, Accepted: 20 December 2020,
Published: 31 March 2021

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Appendix 1: Additional resources

Table S1. Where to find case studies and other lessons that could be modified into distance-learning cases

Resource	Web address
Case Studies in Microscopy	https://courses.cit.cornell.edu/biomi290/microscopycases/
CourseSource	www.coursesource.org/
Data Nuggets	datanuggets.org
Data Science Cases with R	http://rdatasciencecases.org/
Ecology Disrupted	https://www.amnh.org/learn-teach/curriculum-collections/ecology-disrupted
EvoEd Cases	http://www.evo-ed.org/
HHMI BioInteractive	www.biointeractive.org/
MathBench	https://mathbench.umd.edu/index.html
MERLOT	https://www.merlot.org/merlot/
Michigan Sustainability Cases	https://www.learnkala.com/
Molecular CaseNet	https://molecular-casenet.rcsb.org/
Native Cases Studies	http://nativecases.evergreen.edu/
National Center for Case Study	sciencecases.lib.buffalo.edu
Teaching in Science	
National Center for Science Education	ncse.ngo/
NeuroCaseNet	https://qubeshub.org/community/groups/neurocasenet
OER Commons	www.oercommons.org/
Science Education Resource Center	https://serc.carleton.edu/index.html
National Socio-Environmental Synthesis Center	https://www.sesync.org/for-you/educator/case-studies/case-study-collection
Teaching Evolution through Human Examples	https://humanorigins.si.edu/education/teaching-evolution-through-human-examples

Teaching Issues & Experiments in Ecology Journals such as <i>Case Studies in the Environment</i> and <i>Journal of Undergraduate Neuroscience Education</i>	https://esa.org/tice2/ https://online.ucpress.edu/cse and https://www.funjournal.org/
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Table S2. Where to find or produce videos

Tools to create your own videos	Sources for existing videos
Camtasia (\$)	2-minute Neuroscience
Doceri (whiteboard-style videos with voiceover)	https://www.neuroscientificallychallenged.com/2-
Edpuzzle.com (to integrate quiz questions into videos)	minute-neuroscience-videos
iMotion (\$ stop-motion videos)	Amoeba Sisters https://www.amoebasisters.com/
Loom	CSHL DNA Learning Center https://dnalc.cshl.edu/
Mediasite	HHMI BioInteractive https://www.biointeractive.org/
Panopto (\$)	Instructor resources provided with your textbook
PowerPoint voiceover	<i>Journal of Visualized Experiments</i>
Powtoon (simple animated videos)	https://www.jove.com/ (\$)
Screencast-o-matic	Teach.Genetics https://teach.genetics.utah.edu/
VoiceThread (\$ but may be integrated into your LMS)	TED-Ed https://ed.ted.com/
Zoom (\$) or Microsoft Teams	Your Genome https://www.yourgenome.org/

\$=must be purchased

Table S3. Technology to facilitate group work for online case studies

Category	Examples
Video conferencing platforms	Zoom (breakout rooms); Microsoft Teams (channels or breakout rooms with Collaboration space in the Classroom Notebook)
Shared documents	Google Docs or OneNote for written work, data, presentations; Padlet or Google Jamboard for drawings
Online Discussion/Q&A forum	Your Learning Management System (LMS), Piazza, #GroupMe, Slack
Wikis	Your LMS; PBWorks
Social annotation software	Diigo, Hypothes.is, NowComment, Perusall
Concept mapping software (can be used collaboratively)	Cmap Tools, Mindomo, SpiderScribe
Video responses to prompts	VoiceThread, FlipGrid
Polling	Built into Zoom, Teams or your LMS; Poll Everywhere; Kahoot; Socrative

Appendix 2: Summative assessment and technology issues

Summative assessment

While we have illustrated how individual student preparation, collaborative learning, and student synthesis can provide accountability and assessment across learning modalities, case learning outcomes can also be summatively assessed within exams (1). Exams can include multiple choice or short answer questions. Or exams could incorporate data from the case or similar research where students make conclusions based on provided data or perform analyses on their own. Moreover, a new case could serve as an assessment in lieu of an exam (2). Particularly for asynchronous environments, this lessens opportunities for cheating as most case repositories strictly protect their answer keys. We have also extended cases by reintroducing them later in the course, adding new concepts. For instance, a case on evolution was expanded to assess content in ecology. This helps students view assessments not just as an exam but as a learning experience where connections across subdisciplines can be made (3).

Advantages and disadvantages of technology

On a practical note, technology and course delivery is exponentially changing. The downside of this is that instructors must test screen-sharing, breakout rooms, or other tools used, and practice to increase proficiency. This will also increase understanding of the additional time required to switch between programs or screens. Testing technology with another instructor or TA will clarify the student experience and highlight how they will find or interact with the learning modules. Faculty should plan time to teach students how to interact with the technology and knowledge management systems. This can be done via screen sharing during synchronous sessions or a screencast video of the steps needed for asynchronous classes.

The upside of changing technology is finding new ways to incorporate activities that in the past required paper, pen and physical interaction. For example, we have used card sorts (e.g., 4) to challenge groups with categorization of terms (e.g., students arrange cards that list facts about different fossil fuels under the headings “petroleum,” “coal,” “natural gas” or “all 3”). Peer interaction in this activity is quite high (5). To implement online, a shared document (Google Doc or Jamboard) can be created with terms in text boxes. Instead of arranging physical cards, students use their mouse to move the text boxes.

We encourage dialogue with IT staff, faculty learning center, or other instructors to troubleshoot and brainstorm solutions.

References

1. Herreid CF. 2001. When justice peeks: evaluating students in case study teaching. *J Coll Sci Teach* 30(7):430-433.
2. Haswell M. 2020. Using BioInteractive resources in an interactive evolution unit. <http://biointeractive.org> (accessed September 28, 2020).
3. Yadav A, Lundeberg M, DeSchryver M, Dirkin K, Schiller NA, Maier K, Herreid CF. 2007. Teaching science with case studies: a national survey of faculty perceptions of the benefits and challenges of using cases. *J Coll Sci Teach* 37(1):34-38.
4. The Teacher Tool Kit. Card sort. <https://www.theteachertoolkit.com/index.php/tool/card-sort> (accessed September 28, 2020).
5. Rugg G, McGeorge P. 1997. The sorting techniques: a tutorial paper on card sorts, picture sorts and item sorts. *Expert Syst* 14(2):80-93.