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Using Synchronous Labs to Build Online Peer Learning Communities and Maintain a Meaningful Laboratory Experience

Debra Grantham[1], Debbie Fiore[2], Linda Forrester[3] and Elizabeth Welsh[4]

[1]Dalhousie University, Department of Biology, Life Sciences Centre, 1355 Oxford Street, Halifax Nova Scotia B3H 4R2, Canada
[2]Bridgewater State University, Department of Biological Sciences, Mohler-Faria Science and Mathematics Center, Bridgewater, MA 02325, US
[3]University of Rhode Island, College of the Environment and Life Sciences,120 Flagg Road, Kingston, Rhode Island 02881 US
[4]Dalhousie University, Department of Biology, Life Sciences Centre, 1355 Oxford Street, Halifax Nova Scotia B3H 4R2, Canada

(grantham@dal.ca; d1fiore@bridgew.edu; lindaforrester@uri.edu; elizabeth.welsh@dal.ca)

All laboratory educators were thrown into a similar situation by the COVID-19 pandemic. We were all challenged by the sudden shift away from our in-person active learning, hands-on lab activities and student interactions. The need to quickly switch to new online teaching approaches forced us to re-examine and re-prioritize our teaching strategies. To help guide us, we sought inspiration from teaching discussions with colleagues, workshops, consultation with course developers, and established online teaching practices. Converting labs to online resulted in novel approaches that enabled student learning and interaction. Common themes of group work, ability of instructors to easily view student work in progress, use of color and images in lab exercises, shared Excel sheets, and use of peer review emerged during the online lab experience. After our brief presentations, we would like to hear what has worked well for you in a group discussion, with cameras on please. Aspects of these strategies may be useful for us to continue in future, in-person labs.

Keywords: online, synchronous, peer-learning, laboratory approaches, active learning

Introduction

Covid-19 restrictions meant many institutions had to shift to online delivery of biology laboratories and forced instructors to choose methods for delivery of concepts and activities that would still provide experiential learning to engage students. Using synchronous sessions to encourage building a positive learning community that engages students with content through active learning (Stains et al. 2018) and facilitating student connections or social presence through group work (Lowenthal 2009, Weir et al. 2019) were considered important by each of the panelists. The implementation of synchronous lab activities and group work in large, first- and second-year undergraduate biology courses led to a high level of student satisfaction and a meaningful laboratory experience despite the lack of traditional

in-person activities. Innovations and adaptation of successful tools for future terms were discussed in response to the following questions.

Q1. What did you develop that you will you carry into your future in-person labs?

Students attending online labs still needed to prepare ahead of time so they could contribute to the activity and support their group's learning. To address this problem, Fiore had been considering using electronic lab notebooks for several years. She wanted to ease the difficulty in collecting and marking lab notebooks on paper and provide useful experience with e-notebooks to share data in research groups or industry. She introduced pre-lab exercises where students would type into an electronic notebook before attending synchronous labs, and then marked them and adjusted her introductions based on their level of understanding (Blackboard 2021).

A second concern was how students could access help when working on lab assignments. Online, interactive help encouraged more students to attend than ever before. Forrester included a Zoom link within the LMS (Learning Management System) that allowed TAs (teaching assistants) to connect with and talk students through correcting errors in their own R code. Welsh and her lab TAs held multiple online help sessions using Microsoft Teams every other week at the same time as the student's regular synchronous labs to assist with lab assignments. They were able to trouble-shoot R code or data analyses and clarify concepts and assignment guidelines. Students appreciated the convenience of being able to ask a question 'in person' at many different times if they were struggling with the assignments. In the future these online help sessions could allow students to receive help from whatever location they are studying from, such as the library, home or anywhere.

Grantham provided challenging pre-lab questions about the term-long experiment that students were expected to answer orally and had 20-minute discussions with each pod of four students to ensure each student completely understood the potentially confusing yet fundamental reasons for each step in the complicated experiment. Being held accountable and expecting to be called on in their trusted pod provided rich and honest discussions of the level of understanding of each student in the class.

Q2. Do you have any favorite things that worked well online but you may not be able to carry into the face-to-face labs?

Providing an interactive hands-on laboratory experience is one of the reasons biology laboratories are so motivational and providing that immersive experience was implemented in some courses. Forrester developed a 'Take home lab kit' to allow students to perform the experiment at home and collect real data to analyze together online. The simple materials and clear instructions were successful for performing the experiment and will be used in labs in the future, but not as take-home kits because of cost for multiple disposable plastics in each kit. Redesigning labs for at-home experimentation changed the teaching approach to presenting concepts, in some cases highlighting the concepts by removing the use of lab equipment. The take home labs will be used again if pandemic conditions return, and students are again forced to online learning.

Welsh included a successful icebreaker activity where each student created a single introductory PowerPoint slide with images to share with their small groups during the first lab. Students included images from favorite games, their pets, hobbies, and future aspirations. This seemed to build a sense of connectedness and made group work more efficient and more enjoyable.

A participant reflected that Sim Bio's (2020) guppy evolution lab worked well with her course to allow students to generate hypotheses, replicate treatments appropriately, analyze the data, and create graphs to present that data and draw conclusions about their hypotheses.

Q3. How did you get your students to interact during online learning?

A common challenge to both online and in-person labs is to encourage students to participate in group work (Davidson and Katopodis 2020). Fiore created teams of four students and encouraged interaction in the group activities by communicating that they would be assessing each other at the end of term. A simple rubric at the end of term allowed students to report on each other's preparation, sharing, participation, contributions to group assignments and enjoyment for a small portion of their grade.

All authors used breakout rooms of small groups (mostly four students) to promote interactions and encourage discussions and ask questions of the

TAs and instructors as they circulated through the breakout rooms while students worked together on problems. Welsh and Grantham made a point of communicating an expectation that cameras should be on in the small groups if possible, to permit easier communication between group members and to allow identification of understanding or confusion during discussions. Welsh greeted students by name if they entered lab with camera on and thanked them for helping create a positive learning community. Working together on shared Microsoft Word or Excel documents within the Files in Teams also allowed TAs and Instructors to observe progress and detect problems with understanding without peering over shoulders. We could join the breakout rooms and encourage critical analysis of work completed and guide students to problems and allow them to propose solutions.

Q4. What was the hardest aspect of teaching online to resolve?

Teaching online carries a host of challenges that are not part of the in-person laboratory experience. Students are working in their homes, bedrooms, and basements separated physically from their classmates, so building community is much more difficult in online courses (Vesely et al. 2007). Compounding the physical separation, students are emotionally distant and feel awkward communicating and getting to know each other through online portals such as Zoom and Teams. Poor internet connections and infrastructure depends on student location, so we were unable to require video on for every student. Given the option, Forrester found most students did not use webcams, leading to no visual cues to allow TAs to gauge understanding during introductory pre-lab talks. Interactions were more natural in breakout rooms, but lack of web camera use still inhibited natural communication.

Grantham and Welsh had more success by making explicit early in the term that students were expected to have cameras on to ensure smooth communication within their breakout rooms and when talking with the TAs and instructors to aid understanding. Compared to in person gatherings, Welsh noticed a similar lack of ease of communication in her TA meetings. Rather than the easy informality with friendly chatting between TAs as they entered the online room, things were much quieter. Welsh had her TAs take turns asking an icebreaker question at the beginning of each meeting such as "*If you had a superpower, what would it be and why?*" It turned out to be quite fun!

A participant commented that Canvas [and other learning management systems- Grantham] allows us to view what students access and the time spent on each page or video, which could estimate engagement, but access is not the only or best measure of true engagement with the concepts.

The elephant in the room

We all agreed that the major limitation to teaching online was the inability to teach hands-on skills. Kits sent to the student, simulations of laboratory skills like microscope operation, lab equipment operation like pipetting, and serial dilution skills, do not compare well to the experience possible in a face-to-face lab. Students can understand the theory but would likely not be able to complete any of these independently in a lab without the experience and feedback from an instructor.

Q5. What was most surprising thing you experienced about online learning?

Online teaching was new for most laboratory instructors and produced some opportunities that were not expected. Fiore found inspiration for online laboratory design in an opinion piece by Loike and Stoltz-Loike (2020) that proposed a change in focus to experimental design, reading and understanding peer-reviewed articles, data analysis and peer teaching in synchronous sessions. Her implementation of these skills produced a positive response by her students by focusing on skills that usually we do not have time for in a traditional face-to-face lab.

Forrester was surprised by the willingness of students to use online help sessions with TAs. The in-person Intro Bio Computer Help room had been utilized by students, but the online equivalent held through Zoom had many more students meeting with the TAs and requesting help. She will compare online and in-person TA help for Fall 2021 to determine which option is most useful or keep running both for the future. Welsh and Grantham found similar results and will continue online TA and Instructor help sessions for lab assignments to measure effectiveness this Fall and Winter.

Welsh knew that her students came from different geographical locations (and cultures), but it was much more apparent during online courses. She had students identify where they were while studying that term and then made a map of all the places everyone was studying from. It was really fun to see! She believes it is important to make obvious that we are part of a bigger community, and over half of our students are not local.

A participant was surprised by the need for a weekly calendar rather than a schedule in the syllabus covering the whole term. They produced a

weekly calendar at the top of every unit in the LMS to ensure students understood the tasks to be completed each week.

Poll Results

Participants in the discussion were asked to participate in a poll as they entered the meeting. The wording of each question is shown in each figure. Figure 1 shows that despite moving online, 55% of respondents felt that they still achieved their major lab objectives. Another 35% felt that some of their main objectives were met, while only 10% felt their main objectives were not met. In the challenging turmoil of a pandemic, having 90% of lab instructors feel they had met many of their lab learning objectives is a commendable accomplishment.

Going forward into the next year living with Covid-19, many Universities in North America that were online in 2020-21 are moving back to face-to-face classes. The authors questioned if the experience with online teaching and new lab activities they had developed would change their in-person labs by allowing them to incorporate more online activities than in the past. Figure 2 shows that most instructors planned to incorporate a little (65%) to a moderate (25%) amount of asynchronous content to their in-person labs, while only 10% were considering a hybrid model that provided both online and face-to-face activities giving the students the same experience in either mode.

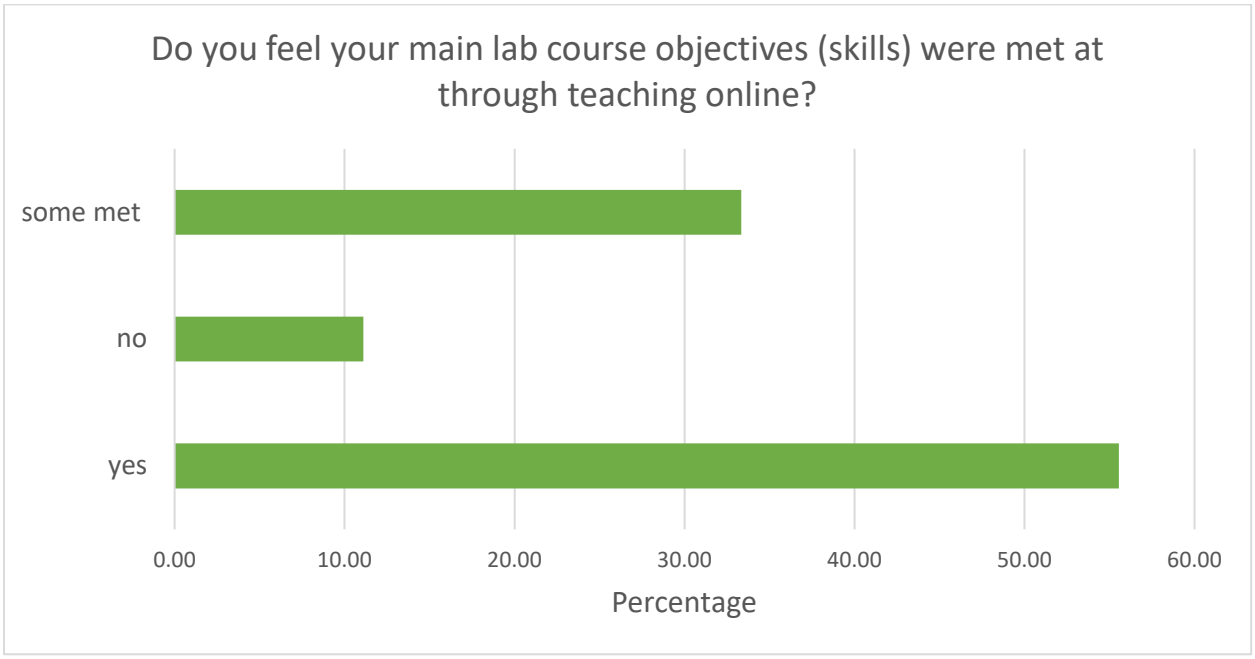

Figure 1. Responses of panelists and discussion panel participants to poll Question 1 preceding discussion.

Figure 2. Responses of panelists and discussion panel participants to poll Question 2 preceding discussion.

Cited References

Blackboard Help 2021. [accessed 2021 Aug. 17] https://help.blackboard.com/Learn/Instructor/Ultra/Interact/Journals?_ga=2.259630281.210387957.1629205675-1047648533.1629205675

Clark RC, Mayer RE. 2011. E-Learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning. 3rd ed. San Francisco (CA): Pfeiffer; [accessed March 2021]. https://a11-389793.cluster11.canvas-user-content.com

Davidson CN, Katopodis, C. 2020. 8 ways to improve group work online (opinion). Inside Higher Ed [accessed 2020 Nov. 27] https://www.insidehighered.com/advice/2020/10/28/advice-how-successfully-guide-students-group-work-online-opinion

Loike JD, Stoltz-Loike M. 2020 April 8. Five objectives for online science labs that lend themselves to virtual teaching (opinion). Inside Higher Ed [accessed 2021 Aug. 11]; https://www.insidehighered.com/advice/2020/04/08/five-objectives-online-science-labs-lend-themselves-virtual-teaching-opinion

Lowenthal PR. 2009. Social Presence. In: Encyclopedia of Distance Learning, Second Edition. Hershey (PA): IGI Global p. 1900-1906. doi:10.4018/978-1-60566-198-8

SimBio. 2020. How the guppy got its spots. [simulation]. simbio.com/content/guppy/

Stains M, Harshman J, Barker MK, Chasteen SV, Cole R, Dechenne-Peters SE, Eagen Jr MK, Esson JM, Knight JK, Laski FA, et al. 2018. Anatomy of STEM teaching in North American universities. Science 359(3683): 1468-1470. DOI: 10.1126/science.aap8892

Vesely P, Bloom L, Sherlock J. 2007. Key elements of building online community: Comparing faculty and student perceptions. MERLOT 3(3): 234-246.

Weir LK, Barker MK, McDonnell LM, Schimpf NG, Rodela TM, Schulte PM. 2019. Small changes, big gains: A curriculum-wide study of teaching practices and student learning in undergraduate biology. PLOS ONE 14(8): e0220900. https://doi.org/10.1371/journal.pone.0220900

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About the Authors

Debbie Fiore is a cell biologist who is a Lab Instructor at the Bridgewater State University, where she teaches introductory biology labs for majors and non-majors and cell biology. Linda Forrester is a marine biologist at the University of Rhode Island where she coordinates and teaches the introductory biology labs. Debra Grantham is a microscopist and cell biologist and now senior instructor teaching the labs and coordinating a large, second-year genetics and molecular biology course at Dalhousie University. Elizabeth Welsh is a University Teaching Fellow (soon to be retired!) from Dalhousie University where she taught and coordinated the second-year core evolution course. She is a geneticist by training and has also taught genetics and introductory biology to majors and non-majors,

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