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Project Summary: Evaluating Effects of Microbiology Lab Formats on Student Engagement, Learning and Identities as Scientists

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Project Summary: Evaluating Effects of Microbiology Lab Formats on Student Engagement, Learning and Identities as Scientists

With improvements in technology, and recent dramatic shifts to increased online learning, interest in using fully online or hybrid laboratories in undergraduate science courses has also increased. At the time this study was designed, the literature contained some studies that examined some aspects of lab format (e.g., Dalgarno et al. 2009, Matz et al. 2012, Rowe et al. 2018), but little had been reported for undergraduate microbiology teaching laboratories. In this study, we explored the effectiveness of online laboratories compared to traditional in-person labs, and a hybrid lab (online, at-home experiments, and on-campus labs) in a microbiology lab course. At the University of Windsor, Introductory Microbiology and Techniques laboratories were fully in-person on campus until the onset of COVID-19. In Fall 2020, the lab component was offered completely online, and relied primarily on pre-recorded videos (all created just before or during the term), new online simulations, and previously collected experimental data to provide content and encourage skill development in the virtual setting (as recommended in Davis et al., 2020). In Fall 2021, a hybrid curriculum was developed (i.e., online, at-home experiments, and in-person lab exercises), with the option to choose a fully online lab section. Using a mixed methods approach (survey and interviews), we investigated student perceptions of their microbiology laboratory experience, comparing responses from students who had completed the course in different formats. Survey questions focused on student reports regarding the quality of their learning in the labs, social aspects, aspects of their learning spaces, and access to computers/technology. The questions were developed based on previously published survey items (Corwin et al. 2015, El Kharki 2021, Gierdowski et al. 2020, Hazari et al. 2013, Lopatto 2004, Pyatt & Sims 2012, Rowe et al. 2018, Vanichvatana 2018), with a few items specific to the course/university. Interviews allowed more insight into the individual experiences of a subset of students who completed different lab formats.

There were 73 full survey responses, including 18 participants who had completed BIOL 2071 in Fall 2019 (traditional, in-person), 18 from Fall 2020 (online only), and 37 in Fall 2021 (hybrid or online). Of the Fall 2021 group, 30 had completed hybrid labs, and 7 respondents were from the 2021 online only section. Survey results indicated some aspects of the lab experiences were similar regardless of lab format, such as access to preferred learning spaces. Differences were seen in responses regarding student confidence in carrying out microbiology lab techniques and reported engagement levels; participants who had the opportunity for some hands-on experience (in fully in-person or hybrid labs) indicated more positive experiences than the online-only participants.

Interviews were carried out with 10 participants who had submitted the survey (3 completed fully in-person labs, 3 completed fully online labs in 2020, 3 completed hybrid labs in 2021 and 1 person who had done the fully online labs in 2021). Interviews revealed specific aspects of in-person, online, and at-home experiments that participants believed worked well, with most describing advantages to having hands-on activities for this lab. Participants also described challenges faced with carrying out online activities and in learning associated with the online-only lab format (e.g., being able to integrate theory and practise, perceived teaching assistant accessibility).

As mentioned in the literature (e.g., Noel et al. 2020), the value of the hands-on experience in the microbiology lab in learning concepts and skills was highlighted in this study, with students showing a strong preference to have at least some hands-on activities in the lab to learn and practise lab techniques. In future, additional interviews could provide a more comprehensive view of student experiences. It would be interesting to carry out similar studies for other biology lab courses, and potentially later cohorts of students who completed in-person labs after having completed at least two years of online courses.

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