In April 2020, New York City’s K–12 schools, colleges, and universities went into lockdown in response to the COVID-19 pandemic, and faculty began converting face-to-face classes into distance learning classes. Teachers and college faculty learned to use new technology to continue instruction for the remainder of the academic year. Learning curves were steep for some, as using technology proved to be overwhelming. Students who registered for in-person classes had to learn in an online environment. Pre-Health Science majors who heavily rely on practical, hands-on courses to gain the necessary skills required for their career participated in virtual anatomy and physiology laboratories. Clearly, face-to-face courses are not always possible; therefore, it is imperative to know the best practices of online teaching and learning.

INTRODUCTION

A curveball was thrown to New York in March 2020, specifically in New York City, where the rate of transmission of COVID-19 had rapidly risen from 27 positive cases in early March to 6,053 cases in early April (1). Biology courses such as general biology, microbiology, genetics, and anatomy and physiology are courses accompanied by laboratory activities that reinforce lecture theory (2–7). Thus, the laboratory allows for the integration of knowledge to bring about meaningful, deep learning rather than superficial learning (8). Deep learning will ultimately lead to transferable skills needed as the undergraduate student pursues advanced biology courses and, more importantly, as undergraduate students enter postgraduate education (e.g., medical school, graduate school) and health science programs (8). The hands-on experiences offered through in-person laboratories are ideal; however, demonstration videos have also effectively promoted student understanding and learning (9–11).

Undergraduate anatomy and physiology courses serve as a prerequisite for many health science programs (12, 13). While students are inundated with human physiological theory in lectures, they enroll in the laboratory, which proves to be equally overwhelming (14). For instance, students learn the physiology of the skeletal system and muscular system in lectures. They then identify bones of the human body, noting articulations and placement of skeletal muscle, respectively. Dissections are also a component of the anatomy and physiology laboratory, providing benefits to those who participate (15). In a study done by Flack and Nicholson (16), students report gaining a better understanding of the human body’s anatomical structure and complexity by participating in hands-on dissections. Flack and Nicholson’s (16) findings also indicate positive experiences from working as a team, which, in addition to improving understanding of human anatomy, provided the necessary support as dissections ensued. Are the positive effects of in-person laboratory experiences transferable to online anatomy and physiology courses? Studies show that students can have positive learning experiences in the laboratory, and the experiences are comparable with face-to-face laboratory courses (15, 17, 18). Below are two recommendations that can enhance an online course.

RECOMMENDATIONS

The use of science demonstration videos

The opportunity to manipulate models to gain a more in-depth understanding of human anatomy is vital to develop transferable knowledge for the health science major. According to Zhang et al. (19), virtual interaction using 3D modeling and simulation in an anatomy course can improve teaching and learning quality. Students in the video group reported more confidence in performing the lab activity based on viewing videos (6). Furthermore, Mutch-Jones et al. (6) found that students who watched short peer-reviewed professional science education videos before and during lab performed better on pre- and post-lab exams. Randler et al. (20) conducted an experimental study on video demonstration on perceived student anxiety and performance. The authors found watching video demonstrations before the actual
dissection reduced student anxiety and improved self-efficacy compared with the group of students who did not watch the dissection video demonstration. Social cognitive theorists define self-efficacy as the strength of an individual’s belief that a task put before them will be successfully executed (21). Most students enrolled in an anatomy and physiology course have plans to enter a health science major or medical school, for which solid foundational knowledge and heightened critical thinking skills are required. The transition to online learning, therefore, makes it even more crucial to monitor student learning gains. To this end, the Biology Self-Efficacy Scale can be used and modified (if necessary) to measure students’ growth in their abilities over the semester (22). The scale can be adjusted for pre- and post-tests to gauge student understanding of a topic.

Interactive videos and game-based learning

Interactive videos used gauge students’ understanding of class topics can be given as pre-assessment or post-assessment quizzes. EdPuzzle is an online interactive video source that can promote student engagement inside and outside the classroom (23). The videos are sourced from YouTube, Khan Academy, National Geographic, and TED Talks. Instructors can search for the appropriate video, embed it with questions, and post it to their classrooms with scheduled due dates. Students watch the video and answer questions (short answer, true/false, multiple choice); once answers are submitted, the video resumes. Grade books will automatically generate as students register for the instructor’s course, allowing for relatively easy instructor grading. Follow-up surveys reveal that students gained confidence in learning the material and improved their focus on the content.

Game-based learning is another active learning tool that has been an effective way to engage students in the classroom (24, 25). Moro et al. (26) used an in-house learning game explicitly designed for first-semester anatomy and physiology students. In addition to the interactive and engaging nature of the game, students report positive experiences such as ease of use and reinforcing concepts learned. Kahoot! is an example of a gaming strategy to engage students in the classroom and monitor student understanding of content that can be used in lecture and laboratory settings. Instructors can create multiple-choice, free-response, or true/false questions on Kahoot!, while lively music and the colorful display capture students’ attention (27). Before launching Kahoot!, instructors should announce to students that the game is low-stakes and serves for content review.

Student’s names appear on the leaderboard screen; as the instructor presents questions, students answer, and points are awarded. The Kahoot! algorithm awards points based on the time it takes to select the correct answer. Student rankings are displayed after each question. The top three players are shown as finalists at the end of each game. While friendly competition arises, students may become discouraged if they do not successfully answer questions (28; C.D., personal observations). To overcome this type of interactive activity’s challenges, one may consider implementing group competition rather than individual competitions (27). Felszeghy et al. (27) used a grouping strategy to encourage students and promote confidence. The Felszeghy study consisted of five different groups, with one of the five groups answering Kahoot! questions individually. Students who played Kahoot! in groups outperformed those who answered Kahoot! questions individually. The results point to the power of discussion and the ability to share ideas and learn from their peers.

CONCLUDING REMARKS

COVID-19 will have long-lasting effects on our economy, environment, and education system for years to come. As we organize lectures and modify e-learning activities for the laboratory, we must also take the time to reflect and consider pedagogical strategies that work well and those that may need to be restructured to promote deep learning in an online environment. As we restructure courses to create well-designed online biology courses, we need to incorporate Biel and Brame’s (29) three recommendations to make matched equivalents to traditional courses. The first recommendations include hosting an online course-specific orientation, which reduces attrition and improves grades in an online biology course (30, 31). The second recommendation is to ensure substantial opportunities for student–instructor interaction, which contribute to student success. While online labs may be asynchronous, reducing the chance to interact, social media can promote student–instructor interactions (32). Biel and Brame’s (29) last recommendation is to include student reflection and self-assessment. In addition to the Biology Self-Efficacy Scale described above, students can also create personal blogs or reflective writing assignments to track their progress through the semester (33). Although the instructor can institute modifications to provide organized e-learning activities for the laboratory, it is the student’s self-efficacy level that will contribute to their academic success (34).

Resilience is defined as the “ability to recover from or adjust easily to . . . change” (35). The foundation of resilience is what we build over time; we are not born with it. We base resilience on the experiences and obstacles we encounter. In higher education, the spring 2020 semester turned chaotic as administrators scrambled to ensure students and faculty had the necessary tools to participate in and conduct online courses. As we prepare phased returns to our campuses, online learning’s pedagogical tools can hopefully translate to or be modified for in-person learning.
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REFERENCES


