Teaching in a Time of Crisis: Editorial Perspectives on Adjusting STEM Education to the “New Normal” during the COVID-19 Pandemic

Loretta Brancaccio-Taras,a Mary V. Mawn,b Josh Premo,c and Roshini Ramachandran d
aCUNY Kingsborough Community College, Brooklyn, New York, USA
bSUNY Empire State College, Saratoga Springs, New York, USA
cUtah Valley University, Orem, Utah, USA
dUniversity of California Los Angeles, Los Angeles, California, USA

The COVID-19 pandemic has forever changed the world, how people interact, and the way business is conducted. Higher education is no exception; as institutions quickly shifted to remote teaching in Spring 2020, many faculty needed to support student learning in ways that were new to them. Typically, online courses are well planned and adhere to the sound principles of instructional design. While the online modality is not new to many, the emergency transition to online learning placed an unprecedented challenge on faculty worldwide. With little time to plan, and in some cases no experience or interest in teaching online, courses were converted to be taught at a distance. Faculty had to think outside the box and make rapid adjustments, revisit learning outcomes, develop flexible expectations, and examine their own teaching practices.

DISTINCTION BETWEEN ONLINE LEARNING AND EMERGENCY REMOTE INSTRUCTION

Intentional online course development and the shift to remote instruction are two distinct processes which we refer to as online learning and emergency remote instruction (ERI), respectively (1). Through the ERI experience, instructors uncovered some significant insights about teaching in a time of crisis. The different articles in this themed issue highlight the many individual and collective experiences of faculty and students during this crisis. Some articles reflect the perspectives of faculty and students who experienced online and remote education for the first time, while others describe research studies that delve more deeply into an aspect of online teaching and how it affected student learning. Taken together, these articles significantly contribute to the field of STEM education because they highlight multiple ways that educators can engage and support diverse learners remotely during these difficult times. Additionally, these articles provide starting points for further exploration as remote and online instruction continue to grow and expand in a post-pandemic world.

IMPACT OF ERI ON “CLASSROOM” INNOVATION AND PEDAGOGY

The events of spring 2020 provided opportunities for educators to engage with students in novel ways and rethink what higher education classrooms will look like in the future. Many instructors decided that the best way to engage with students was to conduct synchronous lectures during the time they would normally meet with students in a brick-and-mortar classroom. In addition, many students watched prerecorded lab techniques in lieu of conducting wet labs. These techniques sought to address the immediate needs of our students, created opportunities for engagement, and allowed instructors to serve their students. However, these “high-immediacy, high-bandwidth” techniques (2) brought to light students’ significant technology needs resulting in lack of access to course materials.

The emergency shift to remote instruction also revealed other insights into the challenges and obligations experienced by our students. These ran the gamut of extended work hours to unemployment, taking care of children who were at home and attempting to be their teachers, and completing all class assignments on a mobile phone so that a laptop could be shared among family members. Moreover, mental health issues were exacerbated as many students were anxious about their family’s health and well-being, and students also experienced loneliness and stress from being socially isolated and in difficult living situations. Moving forward, these experiences need to be discussed and unpacked by educators, so that strategies can be developed based on what was learned during these difficult times to better support student success.

Laboratory courses are a traditional learning experience for STEM students. No doubt, the actual practice of a student running a gel or setting up their first PCR makes students feel like they are scientists. However, the
experiences of the past year have provided a number of questions to ponder. Is it more important for students to develop scientific habits of mind, or to learn how to conduct cookbook protocols? Do labs offered in an online environment allow for more open-ended explorations which previously were not possible due to the time constraints of a typical lab session? Most notably, can students meet lab learning outcomes using online delivery? Many of the articles in this issue conclude that the answer to these questions is “yes.”

MANUSCRIPT HIGHLIGHTS AND FUTURE GOALS FOR THE STEM HIGHER EDUCATION COMMUNITY

In this special themed issue, authors share their pandemic educational experiences. Some have previously published articles about pedagogy and research findings, while others are new to publishing in JMBE. It is our hope that this mix of authors will continue the line of inquiry around teaching through pandemics, natural disasters, and other crises, and thus continue the work of the STEM education community. In some way, all of the articles demonstrate lessons learned that will have positive impacts on instructional practices in the years ahead. The 68 articles published in this themed issue of JMBE represent national and international work conducted at a range of institution types, including liberal arts colleges, community colleges, and research-intensive universities. Five overarching themes emerged which highlight the lines of inquiry related to remote and online teaching and learning. Each of these themes is described below.

1. ENGAGING REMOTE AND ONLINE LEARNERS

The articles in this section begin with exploring how the crisis impacted student engagement in learning, including ways instructors found to maintain engagement during this challenging time. When the crisis began there was significant concern about overall student engagement. To some extent, this concern was warranted. As discussed in “Student engagement declines in STEM undergraduates during COVID-19-driven remote learning,” shifts in student engagement did occur but were nuanced with some forms of engagement remaining constant, while others decreased in alarming ways. This situation resulted in faculty working conscientiously to maintain student engagement. For many, this was done by adapting face-to-face instructional materials to the needs of remote instruction. The articles “Innovation in a time of crisis: adapting active learning approaches for remote biology courses” and “Tunes in the Zoom room: remote learning via videoconference discussions of physiology songs” describe their adaptation strategies. For others, this prompted the development of new ways to engage students beyond those commonly experienced in their face-to-face classes. The articles “Exploring Instagram to promote student engagement in an online didactic environment” and “Online portfolio as an alternative to a research paper as a final assessment” explain efforts to engage students in new and innovative ways. When taken together, these articles show that in the midst of the crisis, diverse opportunities for learning still remained. For example, the pandemic did not stop opportunities for students to participate in internships. “Teaching in the time of COVID-19: creation of a digital internship to develop scientific thinking skills and create science literacy exercises for use in remote classroom” presents an innovative internship experience in which students categorized and annotated episodes of ASM’s This Week in Microbiology. Thus, during this crisis, many faculty committed significant effort to engage students in novel ways to support their learning.

2. ENGAGING WITH THE SCIENTIFIC LITERATURE, CASE STUDIES, AND MODELS

In this section, authors focused their work on the use of research articles, case studies, and scientific models as a means to engage learners synchronously and asynchronously. For example, “Analysis of a COVID-19 clinical trial to emphasize experimental design and quantitative reasoning in an introductory biology course” describes the use of open-access materials from a COVID-19 drug clinical trial to introduce concepts such as experimental design, statistical analysis, graphical interpretation, and the structure of primary research articles. Next, “Three steps to adapt case studies for synchronous and asynchronous online learning” outlines a three-step approach for adapting case studies to the online learning environment. The article “Complex systems in a complex time: two flexible activities using online models to study infectious disease transmission and code complex systems simulations” explains how to use COVID-19 pandemic simulations and infectious disease modeling to engage students in the development and testing of hypotheses. Finally, numerous articles, such as “An approach to asynchronous virtual scientific paper discussions,” “Facilitating engaging journal clubs in online upper-level undergraduate courses,” “Using critical analysis of scientific literature to maintain an interactive learning environment for in-person and online course modalities,” and “Moving a journal article–based upper-level microbiology dry lab from in-person to online instruction” provide concrete steps for developing and assessing remote activities that incorporate the scientific literature.

3. REMOTE LABS AND ONLINE RESEARCH EXPERIENCES

Some of the most challenging areas of ERI were laboratory courses and research experiences, which had to be moved rapidly to a virtual setting during these unprecedented circumstances. Faculty responded quickly and
EDITORIAL

implemented several approaches to design “at-home” laboratory activities as well as research experiences for students. Several articles in this issue provide useful examples for at-home laboratory kits and online CUREs that build upon ASM’s Curriculum and Biosafety Guidelines. Particularly, “Teaching crafty microbiology: safely teaching hands-on microbiology skills at home” describes a safe and low-cost activity to teach students hands-on microbiology skills at home without the use of cultures. Another focus is the tailoring of undergraduate research experiences for online formats. “Development of the organonitrogen biodegradation database: teaching bioinformatics and collaborative skills to undergraduates during a pandemic” details a bioinformatics program where students create a scientific database under the guidance of mentors, while “Student annotations of published data as a collaboration between an online laboratory course and the C. elegans database, WormBase” explains the utilization of an existing database for a collaborative research activity. Other articles offer insights and recommendations for virtual research training and mentoring in various capacities.

4. EQUITY AND INCLUSION IN ONLINE COURSES

In addition to the devastation caused by the pandemic, Spring 2020 will also be remembered for the lives lost as a result of racially motivated violence. These events have caused many faculty to pause and reflect on the materials they use for courses, how content is presented, and whether various populations of students are being served. The article, “Critical OnlineService-Learning Pedagogy: Justice in Science Education” details a service-learning course that incorporates discussion and reflection around issues of racial injustice. In the article “Disparities in Remote Learning Faced by First-Generation and Underrepresented Minority Students during COVID-19: Insights and Opportunities from a Remote Research Experience,” the difficulties brought about by outside factors are presented, including economic and food insecurity, that first-generation and underrepresented minority (URM) college STEM students face. In addition, they report first-generation and URM students experienced greater disparities during remote learning than other student populations. “Effects of Remote Teaching in a Crisis on Equity Gaps and the Constructivist Learning Environment in Introductory Biology” reports that the challenges faced by students from minoritized backgrounds go beyond what can be captured by standard grading practices. The articles in this section serve as a reminder of the significance of thoughtful course designed to address the needs of all students, particularly those from minoritized backgrounds.

5. FACULTY RESPONDING TO CHANGING NEEDS

The articles in this section focus on faculty and their experiences during the pandemic and span institution types as well as professional development in different areas of the world. The article, “Going Online in a Pandemic Time: a DivulgaMicro Workshop Experience,” presents findings from conducting a 3-day professional development workshop for young female scientists in Brazil. In the article, “Teaching during COVID-19 Times: a Community College Perspective,” interviews with community college faculty were analyzed to understand their concerns and experiences about the emergency transition to remote instruction.

CONCLUDING THOUGHTS FROM THE EDITORS

The COVID-19 pandemic significantly impacted the approaches that educators used to engage learners. Faculty developed new teaching, communication, and assessment strategies to ensure quality instruction. Students learned from home in the midst of life disruptions and uncertainty about their health. The innovations developed during this time of crisis will have lasting impacts on higher education and society. While there are technology challenges associated with delivering classes online, there are definite benefits and bigger societal issues that need to be considered. For example, online learning holds the possibility of providing students that cannot attend a college campus with a college credential. There are approximately 36 million individuals in the United States, mostly African Americans, women, and single mothers, with some college and no degree (3). Online learning is one way to increase access to higher education and promote social mobility. Possibly, the information gained from these articles can have a broad impact on the future of accessible higher education.

Furthermore, faculty commitments to utilize inclusive teaching tools, gather feedback from students, and collect information about learning during ERI have paved the way for assessment to become a systematic and essential component of every classroom. The articles in this themed issue provide readers with ideas and data that support ongoing dialogue in the STEM education community and inform teaching practices both during the pandemic and beyond. We encourage faculty to continue their work through data collection and analysis and to develop and share evidence-based practices now and in the future. Additional opportunities for dialogue include: identifying pedagogical best practices for teaching in online environments using synchronous and asynchronous approaches; using what is known about other events that have disrupted instruction, such as natural disasters, to inform our current situation; thinking about strategies to increase student motivation in courses offered at a distance; and using course materials residing in the public domain to increase student access to high-quality educational resources. Finally, as these dialogues continue and more information is garnered, the education community may be able to assess the long-term impact of the pandemic on students’ attitudes about higher education.
We thank all of the authors who submitted manuscripts and then diligently revised and edited them. Also, we acknowledge all of the JMBE manuscript reviewers for their thoughtful feedback and insights that assisted authors in improving their articles. Finally, a special thanks goes to the countless students who continued their studies during these difficult times, and the faculty who re-envisioned their classes to best serve them. All of these individuals persevered through Spring 2020, while continually adjusting to the “new normal” as the world around us continued through the uncertainty of the pandemic.

REFERENCES