All-Online Learning Format Comes with Some Trial and Error

KEEPING students engaged, making sure they understand the material, and creating safe spaces for them to learn take work. In a traditional, face-to-face environment—the "old" normal—these can be challenging to accomplish. But the in-class environment, at least for now, has been replaced by an online one. Depending on the school's level of preparedness, moving classes and labs online can be anywhere from inconvenient to downright daunting, yet instructors around the world are making it happen. And with some schools still uncertain as to whether they will reopen in the fall, many are facing a second semester teaching online.

This month *Civil Engineering* interviewed four college instructors about some of the challenges they have encountered while seeking to quickly establish an online-only learning environment because of restrictions caused by COVID-19.

They include:

• Nephi Derbidge, a lecturer and instructional support technician for the geotechnical, materials, structures, and pavement laboratories at California Polytechnic State University in San Luis Obispo, California

• John Greenleaf, Ph.D., P.E., M.ASCE, the civil engineering program director and an associate professor in the Civil Engineering Department at Quinnipiac University in Hamden, Connecticut

• Jerome P. Lynch, Ph.D., M.ASCE, the Donald Malloure department chair and a professor in the Civil and Environmental Engineering Department at the University of Michigan in Ann Arbor

• Melanie Villatoro, P.E., the department chair and an assistant professor in the Department of Construction Management and Civil Engineering Technology at New York City College of Technology in Brooklyn

Engineering classes and labs have moved online. What were your chief challenges in making that happen?

ND: Some of the challenges have been deciding which software to use, learning how to use new software, and making and editing videos on an aging computer. I've also had to learn how to design an online experience that will be somewhat familiar to students, accept the way I sound and look on the videos, and deal with working mostly alone—without student and faculty interaction.

JG: Classes at Quinnipiac transitioned quickly to an online format. The chief challenge for faculty has been using technologies that we don't typically use. This includes software like Zoom, TechSmith Relay, and Blackboard as well as the hardware needed to provide this content, as there were great discrepancies in what was available to faculty, their internet speed at home, and their technological savvy. Giving exams, collecting and grading work, and posting lecture notes and recordings are just some of the things we had to figure out. Faculty worked extremely hard to pull this off.

The transition wasn't easy for some students either. Although laptops are required of all QU students, the technology is not always equitably distributed. QU set up a fund to help get some of these students what they needed. Some students had to also learn the technology: scanning apps to submit work, take tests online, and videoconference with teachers and professionals (like during our capstone design meetings). It goes without saying that the home environment for many of our students is even more volatile than that of our faculty. Sick family members, lost jobs, and home quarantine being some of the many challenges of having a university community that is largely based in the New York City metropolitan area.

JL: There are as many challenges as opportunities when pivoting to an online learning experience. While online delivery is viable for conveying key course concepts, what is difficult to replicate is the interaction between instructor and student that is essential to specific learner types. For example, it can be difficult for the instructor to "see" students to tell if they truly understand the course material, and students can be shy about asking questions during online lecturing, introducing the risk of losing their attention partway through the lecture.

Another challenge for engineering is that a sizable portion of our curriculum is based on hands-on learning via in-class demonstrations and labs. It is important to remember that a large part of the civil and environmental engineering curriculum is about developing intuition based on feeling and touching the subject matter. While online we can show videos of such experiences, it is a far cry from the real thing. This was extremely difficult to recreate online without extensive preparation.

Finally, often overlooked are questions of equity, as John mentioned. Not all students have high-speed broadband, making video slow and sometimes impossible in real time. We need to make sure as institutions that we live up to our values of ensuring equal access to our educational experiences. It remains a complex issue for many institutions.

MV: The biggest challenge was transferring from hand notes to PowerPoint. My in-class lectures incorporate usually two or three slides of theory, and the rest of the time is spent doing calculations. I know all my students' names and I am used to calling on them, but now all I see are boxes with their names on them. They all need to be muted otherwise the sound quality suffers. I cannot see their faces to determine whether they have a confused look or that "Aha!" look.

I have been lucky with very good attendance from my students during lec-

tures, but the assignments were not submitted on time or at all. As chair of the department it has been a daunting task to transfer more than seventy courses online and train forty-plus faculty.

What are the chief differences in how you teach online versus in person? How are you resolving those challenges?

ND: Learning checks, administering exams, and discouraging cheating have been more challenging in a virtual environment.

JG: Typically, our classes are very small (less than twenty-four students) and highly interactive. In the classroom, all our faculty follow an ASCE ExCEEd-based model for course content delivery. [Excellence in Civil Engineering Education (ExCEEd) is a six-day faculty training program that provides engineering educators with opportunities to improve their teaching skills.] We use blackboards and whiteboards to a significant degree, and [there is] a great deal of active learning and questioning. While it would have been easier moving to a prerecorded, PowerPoint-based format, we have tried, when possible, to maintain live lectures at scheduled class times and an interactive classroom. In my online course, for instance, I called on students regularly. They took notes based on the notes, slides, and work I presented.

JL: The major difference is that the online platform is an added layer of abstraction between the instructor and student. For example, it is very difficult for instructors to see students and to react to facial and behavioral expressions that teachers use to gauge the effectiveness of their teaching. We have been proactive in using online surveys to query the students to get real-time feedback that is passed on to the instructor. This process allowed them to iteratively shape the way they delivered content. We will continue to do this and improve our processes.

MV: My class is a design course, which requires a lot of calculations. In person, I use the whiteboards to organize my lecture and include a lot of examples. To teach online, I bought a drawing tablet that I attached to my computer to write out the examples because

it would take too long to type out the equations.

Are there any subjects or concepts that you are going to have to wait to teach until you have the students back in the classroom?

ND: We are targeting our learning outcomes for each course in the online environment.

JG: No. Concept-wise, pretty much anything can be taught online. It is the hands-on portion that suffers. For example, surveying can be demonstrated in an online format, but it is not the same as going into the field and actually working with the instruments. The same can be said for labs, site visits, and other activities.

JL: We can cover almost the entirety of our curriculum online. It is not really a question of what you cannot do, but really a question of how much effort is required to use online delivery effectively so that we do not compromise the quality and impact of our learning experiences.

MV: Some labs were extremely modified. We have had to adapt some of them to simulate the process through software. Unfortunately, however, students lost the hands-on learning aspect of building a model house or fabricating a steel connection. Some courses use certain software—such as Revit [by Autodesk] and ArcGIS [by the Environmental Systems Research Institute]—that have been a challenge due to accessibility. Some [students] will have to finish their coursework over the summer to complete their grades. What's more, we will not be able to provide the American Concrete Institute's concrete technician certificate, because it involves a performance test which we cannot prepare them for.

How are you handling online labs?

ND: Of course the best lab instruction would be in person with a tactile experience. We run our online labs to maintain Cal Poly's "Learn by Doing" motto through a variety of efforts. For geotechnical labs we made point-of-view videos. Viewers will receive some sort of "hands-on" experience since they are seeing my hands perform some of the laboratory tests. I provided commentary to explain

how and why tests are performed. Some laboratory tests present well by simply videoing our normal lecture and demonstration. We ask students to refer to the data sheet and report requirements while watching the video. For example, videos for hydraulic conductivity tests provide actual measurements for students to record and calculate results. This requires students to engage in learning while viewing the video.

JG: These are the most difficult of all, as they are very hands-on. All labs are online, using online resources (demonstrations and activities) developed by the faculty. For us, the fall semester tends to have a heavier lab component, so we were lucky in this respect and it has not represented such a problem. Also, many of our spring classes were more than halfway through the semester before the transition. In this sense, a good amount of the lab content had been in-person until now. Undoubtedly, this represents our greatest challenge should this crisis last into future semesters.

JL: It's been the same for us at Michigan. Most of our labs were halfway through the semester before we pivoted to online. This allowed our students to have many in-lab experiences already. For the rest of the semester, many of our instructors went into the lab to record themselves performing the experiments, with the raw data provided to the students. The students then carried out the lab remotely. While this is not a perfect substitute for the lab experience itself, it was a pretty good surrogate for these difficult times.

MV: We created simulations using software, and in some cases the faculty were able to record the lab procedure for the students prior to the closure of campus.

Mitchell

—MARGARET M. MITCHELL

Margaret M. Mitchell is the managing editor of Civil Engineering.

Do you have an innovative program for reaching and teaching today's technology-savvy civil engineering students? If so, email cemag@asce.org using the subject line "Higher Learning."