2021 ASEE ANNUAL CONFERENCE
Virtual Meeting | July 26–29, 2021 | Pacific Daylight Time
Paper ID #32647

Lessons Learned: How Our Agile Department Survived the COVID-19 Pivot

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Laura Gelles is a postdoctoral research associate at the University of Texas at Dallas within the Erik Jonsson School of Engineering and Computer Science where she is studying retention of undergraduate engineering students. She has extensive experience using qualitative and mixed-methods research in Engineering Education. Before joining UTD in September 2020, Laura worked at the University of San Diego on their RED grant to study institutional change efforts and redefine the engineering canon as sociotechnical. She has a background in environmental engineering and received her Ph.D. in Engineering Education at Utah State University with a research focus on the ethical and career aspects of mentoring of science and engineering graduate students and hidden curriculum in engineering.

Dr. Susan M. Lord, University of San Diego

Susan M. Lord received a B.S. from Cornell University in Materials Science and Electrical Engineering (EE) and the M.S. and Ph.D. in EE from Stanford University. She is currently Professor and Chair of Integrated Engineering at the University of San Diego. Her research focuses on the study and promotion of diversity in engineering including student pathways and inclusive teaching. She is Co-Director of the National Effective Teaching Institute (NETI). Her research has been sponsored by the National Science Foundation (NSF). Dr. Lord is among the first to study Latinos in engineering and coauthored The Borderlands of Education: Latinas in Engineering. Dr. Lord is a Fellow of the IEEE and ASEE and is active in the engineering education community including serving as General Co-Chair of the Frontiers in Education Conference, President of the IEEE Education Society, and Associate Editor of the IEEE Transactions on Education (ToE) and the Journal of Engineering Education (JEE). She and her coauthors received the 2011 Wickenden Award for the best paper in JEE and the 2011 and 2015 Best Paper Awards for the IEEE ToE. In Spring 2012, Dr. Lord spent a sabbatical at Southeast University in Nanjing, China teaching and doing research. She is on the USD team implementing ”Developing Changemaking Engineers”, an NSF-sponsored Revolutionizing Engineering Education (RED) project. Dr. Lord is the 2018 recipient of the IEEE Undergraduate Teaching Award.

Prof. Gordon D. Hoople, University of San Diego

Dr. Gordon D. Hoople is an assistant professor and one of the founding faculty members of integrated engineering at the University of San Diego. He is passionate about creating engaging experiences for his students. His work is primarily focused on two areas: engineering education and design. Professor Hoople’s engineering education research examines the ways in which novel approaches can lead to better student outcomes. He is the principal investigator on the National Science Foundation Grant ”Reimagining Energy: Exploring Inclusive Practices for Teaching Energy Concepts to Undergraduate Engineering Majors.” He has also co-developed a unique interdisciplinary course, Drones for Good, where engineering students partner with peace studies students to design a quadcopter that will have a positive impact on society.

Dr. Joel Alejandro Mejia, University of San Diego

Dr. Joel Alejandro (Alex) Mejia is an assistant professor in the Department of Integrated Engineering at the University of San Diego. His research has contributed to the integration of critical theoretical frameworks and Chicano Cultural Studies to investigate and analyze existing deficit models in engineering education. Dr. Mejia's work also examines how asset-based models impact the validation and recognition of students and communities of color as holders and creators of knowledge. His current work seeks to analyze and describe the tensions, contradictions, and cultural collisions many Latino/a/x students experience in engineering through testimonios. He is particularly interested in approaches that contribute to a more expansive understanding of engineering in sociocultural contexts, the impact of critical consciousness in engineering practice, and development and implementation of culturally responsive pedagogies in engineering education.

Prof. Mark A. Chapman, University of San Diego

Mark Chapman is an assistant professor at the University of San Diego in the Department of Integrated Engineering. His interests lie in the fields of skeletal muscle mechanics, muscle disease, exercise physiology, international education and engineering education. He earned his MS and PhD in bioengineering from the University of California, San Diego and a B.S. in biomedical engineering from the University of Minnesota.

Lessons Learned: How our agile department survived the COVID-19 pivot

Introduction

When the coronavirus began spreading rapidly in the United States in early 2020, institutions of higher education watched as leaders shifted responsibility down the leadership ladder until individual faculty with authority over only their classroom were forced to make decisions according to their own ethics. We were lucky to have a dean and a department chair who took on the leadership mantle. Our dean initiated weekly Zoom updates for the school to share quickly changing news and decisions made by university leaders, and to be transparent and open to questions. Our department chair is deeply integrated in our program's teaching and led the charge as we pivoted to emergency remote teaching (ERT) halfway through the Spring 2020 semester. In this paper, we reflect on how our department's faculty successfully navigated the transition to ERT and share lessons learned on how we continue to maintain high quality education while online. We have also reported elsewhere on our students' responses to the adjustments made during the COVID-19 pandemic using a compassionate flexibility model [1].

Establishment of a Virtual Community of Practice

Before the pandemic, our department of five faculty already had strong relationships and a network of support. When classes were cancelled for a week to prepare for the pivot to ERT, we quickly established an online community of practice. We searched for a technology platform that could mimic our informal communication pathways (i.e., popping into the office next door for a quick question, break, or brainstorming session). We assessed what technology we had available and how to use it effectively (e.g., iPads, webcams, microphones, etc.). Over the span of a few days, we vetted several messaging applications (e.g., text messages, WhatsApp, GroupMe, Hangouts, Slack) and chose Slack as a good fit for our department's communication needs.

During the week classes were cancelled, our department had multiple spontaneous and informal Zoom training sessions to practice the new technology to learn how to better facilitate remote teaching. For example, one faculty member might ask on Slack if anyone was free to troubleshoot new hardware setups or the entire department would join an impromptu Zoom call to practice hosting breakout sessions. These training sessions allowed us to practice using various platforms as an instructor and to experience the platform in ways that students would.

Student-Facing Efforts

As a department that values inclusion, we naturally had a strong commitment to the support and success of our small student population. During ERT, students were stripped of their low-barrier engagement method with their professors and faced new challenges regarding how to navigate professionalism in an online setting, with formal communication through email being one of their only familiar tools. Before we launched ERT, we sent out surveys to collect student information (i.e., their time zone, access to internet and webcams, how they were coping and any questions they had, etc.). We discovered that, in the same way emails did not meet our faculty needs, we needed communication methods for our students so that they could reach us quickly and in similar ways as to in-person, such as "popping into office hours" when on campus. Slack was also well suited to meet this need. We also committed to a united front to minimize students' cognitive and technology overload by sharing consistent communication tools, learning management systems (LMS), and a single "student resources" page that we built collaboratively. Luckily, all of the faculty in our department already used the same LMS prior to the transition to

online. Although Blackboard has its problems, the transition to ERT solidified our commitment to using this platform to reduce students' cognitive loads in navigating between multiple technologies for each of their classes. Our goal was to minimize the number of online tools needed to provide a good learning and communication experience for students.

Three themes stand out when reflecting on what made our department successful in our transition to ERT. First, we are a small, quick moving unit in comparison to the university as a whole, the school of engineering, and even the other engineering departments. We attribute our ability to quickly establish functional communication pathways to the agility of our unit. Second, prior to the transition to ERT, we all already used digital tools for lectures (e.g., PowerPoint) and Blackboard. We were able to quickly create an online community of practice because we shared a similar understanding of how to use these basic digital tools. Lastly, we were comfortable learning and testing new technologies quickly because the majority of us are digital natives. Our department chair, who is not a digital native, provided perspective on how our digital presence might resonate with students. Diverse representation within our team helped ensure access for a diverse audience. It can be problematic to assume that all students are digital natives -- while a handful of our students already have industry experience using online tools, others come to class struggling with technological literacy. Even if they were familiar with the technology, students often needed guidance about how to use it professionally. For example, detailed directions on how to prepare and submit homeworks (e.g., as one pdf, using a scanner app, not including extraneous material underneath the images) was helpful.

Lessons Learned

1) Establish Clear and Effective Communication Quickly

The first things we did were to understand the new situation and lay new groundwork for what remote learning would look like. During our transition week, we coordinated surveys to students to determine what resources they had access to (e.g., webcams, quiet spaces, reliable internet connection). We redesigned our courses and projects around these responses and did our best to help students acquire resources when needed. Our first day of remote teaching was set aside for answering questions about the pandemic and university plans and explaining new expectations and changes to grading (e.g., out of class activities or group work that were eliminated), updated learning objectives (due to the loss of a week of class time), assignments and exams (e.g., how to complete and submit, how exams would be administered), and class policies (e.g., attendance policies adapted around internet connection, what class participation looked like, if webcams were required, data privacy concerns, etc.). We displayed new online course layouts, showed students how to use new software and platforms, and instructed them on online etiquette.

2) Redesign class activities within new constraints

While the preparation for ERT was challenging, the continued efforts to maintain effective teaching were the most taxing. To provide quality education, we worked to redesign class activities within new remote constraints. For example, one lab instructor pre-recorded multiple video clips of himself walking through data collection. Students completed lab exercises by viewing the short data collection video clips and analyzing the resulting data together in their breakout rooms. Redesigning class activities to fit the new constraints created more work for the instructor, both in preparation for class and in grading, but we saw these efforts as necessary for bolstering student motivation to continue to engage in class.

Digitize active learning
While our faculty were already familiar with using active learning [2], moving it into a virtual space took creativity and time. One of the most impactful consequences of moving online that we observed was that students were stripped of their social interactions with classmates, such as chatting before the start of a lecture, working through problems together in class, and building social ties through a shared experience. While students were often quiet and literally muted during lecture, they brightened up in breakout rooms. We found that, for classes in which students already had social connections, the breakout sessions motivated them to continue coming to class to see their friends. To facilitate in-class group work and activities, we created worksheets using Google Docs for students to work on collaboratively in breakout rooms. An advantage of this approach was that the instructor could observe students' thinking and teamwork process, and provide feedback directly to each group in real-time without interrupting their conversations. For one-minute papers, we used Google Forms or created a Blackboard "reflection assignment" for students to complete synchronously or outside of class.

Acknowledge student differences in fatigue from and access to remote learning
In addition to spending hours in front of a screen that replaced social interaction in a classroom, students' methods of collaboration for group work and engagement with course material also changed dramatically. We updated our class attendance or participation expectations to accommodate connectivity issues or lack of private spaces for attending class in. We communicated that while we preferred the community environment when we could see students' faces, turning off webcams to accommodate limited data speeds was an acceptable trade-off for attending class synchronously. For outside of class interactions, we provided students a way to contact us informally (chat via Slack), and offered impromptu video office hours with them when needed. This worked quite well for some students. During Spring 2020, we were more flexible with the times we were willing to meet with students (e.g., in the evenings), which allowed for more opportunities for interaction.

One minor lesson we learned was the unreliability of playing videos in class due to buffering time, sound issues, and inconsistent internet speeds between students. We found that sharing the link to the video to have everyone watch on their own machines simultaneously (instructor included) provided benefits in addition to circumventing the technology issues: students could watch at a speed appropriate for them, turn on/off captions, and revisit it later to review.

At a larger scale, we also provided students more flexibility in how they preferred to complete the semester logistically. In one lab class, where students were sent home with "lab kit baggies" that contained limited supplies and portable equipment to finish the semester, students were given the option to choose their project teams based on any information they had about their classmates, including their program concentration area, what sensors they had, and who their friends were. In one class where students originally were assigned homework teams, they were given the option of continuing with their team or completing the rest of the semester individually as they could no longer meet in person and not everyone was in the same time zone. In one project-based class, students could choose to complete the original group project, or opt for an entirely different individual project they could complete on their own time and terms.

Avoid penalizing students for something that is not their fault (the pandemic)
For exams we chose compassion rather than to increase surveillance levels and assume students are inherently cheaters. The faculty in our department approached this problem in various ways. One faculty member changed the final exam to be optional so that only students who were on the borderline of a grade they were aiming for had incentive to take the exam. (Sharing with students whether their exam score would make a difference in their grade is important for this approach.) Many of us adapted our exams to be take-home to avoid the invasive nature of exam proctoring software. Techniques we used to prevent cheating included (1) require students to use the internet to answer certain questions (and cite their work) given that they all already were on their computers, (2) ask questions that depend on students' lived experiences (e.g., apply lessons to their hometown), which inherently could not be replicated between people, and (3) ask application questions as much as possible.

Student Responses to Our Actions
In conclusion, we will present how our students responded to our efforts through our combined course evaluations. Our course evaluations were adapted to consider the transition to ERT. As seen in Table 1, students appreciated our efforts with around 80% strongly agreeing and over 98% agreeing that the instructor was available, inclusive, and communicated and used tools effectively.

Table 1. Data from end of semester course evaluations for 9 courses taught by faculty authors in Spring 2020 (N = 125). RL is "remote learning".

	Strongly Agree (5)	**Agree (4)**	**Neutral (3)**	**Disagree (2)**	**Strongly Disagree (1)**	**Mean**
The instructor was available to students outside of class meetings	100	23	2	0	0	**4.72**
The instructor created a welcoming an inclusive learning environment	103	21	1	0	0	**4.82**
The instructor effectively used RL tools (e.g. Zoom or Blackboard)	99	25	0	0	0	**4.80**
The instructor communicated effectively after the change to RL	103	22	0	0	0	**4.82**

In response to the question "In what ways did the instructor effectively adapt to remote learning?" students often mentioned communication platforms such as Slack and Blackboard and instructor flexibility. For example, students reported that their instructor:

- "made great use of both blackboard and slack … Class resources were easy to navigate and communicating with the instructor and class online was easy to do."
- "already had used blackboard and organized a lot online, so the transition wasn't too hard or much different. After remote learning she gave us more options for assignments and projects to make it easier on us while keeping the same level of learning."
- "gave us many options on how this class was going to be taught … so most of our time in class was not just a typical lecture setting."
- "effectively used breakout rooms, understand how difficult it is for students during this time, adjusted classes based on our energy level, encourage[d] us to turn our videos on and engage, used Slack as a communication platform, and had us present via zoom."

References

[1] L. A. Gelles, S. M. Lord, G. D. Hoople, D. A. Chen, and J. A. Mejia, "Compassionate Flexibility and Self-Discipline: Student Adaptation to Emergency Remote Teaching in an Integrated Engineering Energy Course during COVID-19," Education Sciences, vol. 10, no. 11, p. 304, Oct. 2020.

[2] R. M. Felder and R. Brent, *Teaching and Learning STEM: A Practical Guide*. San Francisco: Jossey-Bass, 2016.