An exploration of engineering instructors’ pedagogical adaptations early in the COVID-19 pandemic

Matthew J. Manierre¹ | Jan DeWaters² | Seema Rivera³ | Martha Whalen⁴

¹Department of Humanities and Social Sciences, 279 Snell Hall, Clarkson University, Potsdam, New York, USA
²Institute for STEM Education and Coulter School of Engineering, Clarkson University, Potsdam, New York, USA
³Institute for STEM Education and Department of Education, Clarkson University, Potsdam, New York, USA
⁴Department of Humanities and Social Sciences, Clarkson University, Potsdam, New York, USA

Abstract

Background: Many instructors made an emergency shift to online teaching during the Spring 2020 semester. There is reason to expect that instructors would have dramatically changed their pedagogy and teaching philosophies. At the same time, there are reasons that engineering instructors might be hesitant to introduce some changes to their courses.

Purpose/Hypothesis: This study explores pedagogical and philosophical adaptations using instructors’ accounts of emergency remote teaching during the Spring 2020 semester.

Design/Method: In-depth interviews with six engineering instructors were conducted to examine their teaching experiences and the way they responded to the online transition. Interview transcripts were analyzed for general themes and commonalities.

Results: Instructors made many changes during the transition, some of which were general and others individualized after a problem came to their attention. However, other changes were uncommon or even avoided, in particular, reducing content difficulty and shifting their teaching philosophies. Our interviews suggest several explanations for their choices, including the degree to which course design rendered change unnecessary, or the influence of the instructors’ existing skillset, their desire to protect the validity of grades, and their sense of the scope of engineering pedagogy.

Conclusions: These interviews contribute to our understanding of how the emergency transition to online teaching impacted engineering instructors and how instructors might improve resilience during future crises. The conceptual tools and thought processes elucidated by this study can inform future analyses. Further research should pursue comparisons with other disciplines and consider the long-term effects of pandemic teaching.

KEYWORDS
COVID-19, instructional methods (synonym: pedagogy), teaching philosophies, teaching skills
INTRODUCTION

The COVID-19 pandemic represented a major disruption to the Spring 2020 semester with a sudden, forced transition to online teaching for instructors at many institutions of higher education. At the same time, instructors were subject to all the stresses of a worldwide pandemic: anxiety about their family's safety, caregiving challenges as K–12 schools shifted online, and job security as university budgets became uncertain. Students were rendered vulnerable in ways previously hidden from instructors: they faced disparities in technology and Internet access, housing insecurity, parental job loss, family responsibilities, and the possible need to unexpectedly take on a job during the semester (Beaunoyer et al., 2020; Doyle, 2020).

Nevertheless, Dasgupta and Nascimento (2020) emphasize that “there is a rupture in higher education and in that rupture is an opportunity.” Although stressful, the emergency transition online and the sudden destabilization of higher education have offered an opportunity for reflection, introspection, collaboration, and reinvention of instructors’ approaches toward teaching and students. A preliminary focus group by Whiteside et al. (2020), for instance, suggested that the pandemic functioned as a vehicle of “disruptive innovation,” creating opportunities for empathy, collaboration, and support. This is further evinced by a growing number of studies documenting changes in teaching strategies, as well as blogs and reviews offering advice and best practices in engineering (Balakrishnan & Malim, 2020; Bennett et al., 2021; e.g., Clark & Besterfield-Sacre, 2020; Culbert, 2021; Deutschman et al., 2021; Gelles et al., 2020; Jenkins, 2021; Marquez & Garcia, 2021; Park et al., 2020). Like much of the literature on crisis teaching produced before the pandemic, which focused on teaching in the context of acute traumas, such as school shootings, natural disasters, and terrorist attacks (e.g., Chodosh, 2002; Elbih, 2013; Foster, 2006), these publications largely emphasize course content and student outcomes. Discussions of how the pandemic affected the way faculty think about and approach teaching and learning, and their relationships with their students, are rapidly developing in light of emerging evidence.

In this article, we explore how six engineering instructors at a small research university in rural northeastern United States approached their teaching during the emergency transition to online teaching in the Spring 2020 semester. At that time, each was challenged with balancing competing priorities about changing—or not changing—their courses. We address the various adaptations instructors made to their courses, as well as the changes they avoided. We then examine the reasons and motivations underlying these decisions to gain a better understanding of how engineering instructors react to emergency teaching.

Our analysis explores pandemic-inspired changes that instructors made, specific to both their teaching philosophy and pedagogical practice. In this study, we adopt Beatty's model for understanding teaching philosophies as the main component of our conceptual framework. Beatty defines teaching philosophy as one's “conception of teaching, including the rationale for one's teaching methods … [one's] holistic views of the teaching process, including one's thoughts about the definitions and interaction between learning and teaching, perceptions of the teacher's and student's role, and goals and values of education” (Beatty, 2009, p. 100). A teaching philosophy is eminently personal: it reflects the essence of an instructor's core values, their engagement with different educational paradigms (e.g., feminist versus pragmatist), and their assumptions about student capacity for learning (Kunac, 2020). This is more than just an abstractly written teaching statement—it requires internalization and consistent practice. In this vein, pedagogy refers to how educators set their teaching philosophy into motion via instruction, course design, assessment structure, and engagement with students (Ironsie, 2001). Although some may use these two terms interchangeably, in this work, we consider them separately but acknowledge that the two ideas are interrelated, with teaching philosophy providing a framework or “guard rails” against which pedagogical decisions (or pedagogical practice) are made.

Additional studies continue to emerge about instructors’ experiences during COVID-19 and how they have modified their courses (e.g., Asgari et al., 2021; Cameron-Standerford et al., 2020; Jankowski, 2020; Johnson et al., 2020; Kim et al., 2021; Leung et al., 2020; Sheppard, 2020; Whiteside et al., 2020). A recent study by Asgari and colleagues (Asgari et al., 2021) surveyed engineering instructors and students about the online transition, focusing on assessment methods and hands-on training during and following the Spring 2020 semester. Their survey highlighted instructors’ struggles with technology and the loss of connection to students, with little attention given to exploring how instructors rationalized their course changes or even what changes were adopted. Our study complements this extant research, primarily quantitative, with a rich qualitative exploration of instructors’ experiences from interviews immediately after the Spring 2020 semester ended. Moreover, we concentrate on engineering instructors under distinct institutional constraints, including accreditation requirements and rigidly structured curricular sequences.
1.1 The effects of emergency remote teaching on pedagogy

The concept of emergency remote teaching (ERT), as described by Hodges et al. (2020), is distinct from conventional online teaching due to its urgency and the lack of infrastructure to support instructors. The transition online and the broader cultural climate during Spring 2020 generated an environment that forced instructors to reconsider aspects of their teaching (e.g., Cameron-Standerford et al., 2020; Deutschman et al., 2021; Gelles et al., 2020; Kim et al., 2021; Leung et al., 2020). Universities responded by providing informal and formal skill-swapping opportunities and offering feedback on class observations from expert staff (Clark & Besterfield-Sacre, 2020; Whiteside et al., 2020). Articles in trade publications probed questions related to the ethical dilemmas instructors confronted trying to adequately assess students while also accommodating those who were struggling (Flaherty, 2020; Jankowski, 2020); deciding whether to pivot to online asynchronous or synchronous formats (Culbert, 2021); defining the workloads to be prescribed (Lederman, 2020); and even addressing the limits of professionalism and the importance of maintaining professional appearances mid-pandemic (Barchas, 2020). These publications highlight the pressures that instructors negotiated as they adapted their courses.

Gelles et al. (2020) drew parallels with prior crises, including natural disasters, wars, and acute traumas, such as school shootings. Their interviews with engineering students during the pandemic are consistent with the literature on other ERT situations, illustrating three hurdles students and instructors faced: changes in workload, inconducive learning environments, and communication issues due to asynchronous communication and lack of technology access. Other researchers documented a heightened need for student accommodations due to strain caused by financial crises, relocation, family COVID-19 infections, burnout, and mental health issues (Asgari et al., 2021; Crick et al., 2020; Means & Neisler, 2021). These challenges drove instructors to seek pedagogical changes and adaptations, often spontaneously drawing on informal social networks to accommodate gaps in their knowledge.

The literature points to a spectrum of pedagogical responses. Interviews with engineering students (Gelles et al., 2020; Marquez & Garcia, 2021) documented instructors’ adjustments such as increasing communication, reducing workload, initiating homework problems during class periods, granting extensions with little scrutiny, and—in general—an increased effort to effectively adapt to the new online learning platform by communicating and teaching via multiple methods. Hickling et al. (2021) documented similar changes among public health instructors, identifying 23 different options for adapting existing courses, including prerecording lectures, introducing asynchronous elements, and incorporating polls within synchronous sessions. These interview studies are corroborated to some extent by broader faculty surveys. For example, Jankowski (2020) found that 97% of faculty made at least some changes to their assessment methods or standards. These changes point to shifts in the pedagogical approaches of instructors in light of the pandemic but not necessarily to corresponding changes in their teaching philosophy.

1.2 The effects of emergency remote teaching on teaching philosophy

In this study’s conceptual framework, teaching philosophies are the product of, among other things, an educator’s culture, experience level, training, job expectations, and life experiences (Kunac, 2020; Laudon, 2020; Oleson & Hora, 2014; Swartz, 2003). Teaching philosophies may change over time as instructors progress in their careers, gain access to new technologies and methodologies that assist with teaching and learning, or through their experiences with students and their personal, societal, or historical developments (Beatty et al., 2020; Buswell & Berdanier, 2020; Gardner, 2010). In a recent interview study, Buswell and Berdanier (2020) found that engineering instructors, in particular, tended to adjust their teaching conceptions and philosophies continuously over time, to accommodate for discrepancies between their expectations and the realities of teaching and academic work.

It follows, then, that the experience of teaching in a global pandemic may catalyze instructors to revisit their teaching philosophies to reconcile tensions and contradictions identified by the crisis situation. For instance, Beatty et al. (2020) describe how the pandemic challenged instructors to reconsider their beliefs about online teaching:

Some faculty members, like Jennifer, who were philosophically opposed to fully online education, are required to adapt to this format, at least for the near term. This inescapable policy mandate has forced her to confront deeply held views about teaching and learning. ... Contrary to her long-held beliefs, she continued to develop connections with students especially in small group breakouts where there was sufficient time to talk (pp. 535–536).
Other researchers have documented engineering instructors adopting policies that contradict or reprioritize existing values, for example, the importance of difficulty, academic integrity, and ideal methods for content delivery (Cameron-Standerford et al., 2020; Davis et al., 2021; Deters et al., 2020; Gelles et al., 2020; Kim et al., 2021; Tsai et al., 2020). Also observed was a reconsideration of the importance of peer-to-peer and instructor-to-student caring and communication (e.g., Atman, 2020; Gelles et al., 2020; Miller & Jensen, 2020; Sheppard, 2020). Deutschman et al. (2021) suggested that these changes were driven by a sense of dissatisfaction with current teaching methods and environments, challenging instructors to experiment with ways to resolve the dissonance.

These adaptations may challenge a person’s entrenched philosophy, opening the opportunity for longer term changes. And of course, the expectations, values, and assumptions of many instructors were challenged as they were exposed to social inequalities that impacted their students during the COVID-19 pandemic—including, for example, the digital divide (Beaunoyer et al., 2020; Burke & Collier, 2020; Whiteside et al., 2020), students' economic and spatial precarity (Asgari et al., 2021; Crick et al., 2020), and racial injustice (Sheppard, 2020). The shift to ERT may also have accelerated a logical continuation of curricular development and philosophical exploration that was already underway in some engineering departments (Davis et al., 2021; Deutschman et al., 2021). For instance, Davis et al. (2021) found that their earlier efforts to promote an inclusive and diverse culture within their engineering department became particularly significant. Whether instructors were forced to redesign their courses in a high-pressure environment or were simply required to accelerate change that had previously been set in motion, the COVID-19 pandemic provided ample inspiration for experimentation, reflection, and retooling not only pedagogy but also deeply held values about effective teaching, equity, and duty to students.

1.3 Competing expectations about change

Although changes in teaching practice are commonly assumed to result from changes in philosophy or beliefs (J. Richards et al., 2001), an existing teaching philosophy may guide or inform decision-making without undergoing a complete transformation. Our conceptual framework, as elaborated on by Beatty et al. (2020), suggests that teaching philosophies often represent “guard rails” that guide creative teaching decisions. If teaching philosophies are the product of slow growth from years of experience and reflection (Alhawawi & Jawhar, 2021; Rasheed et al., 2020; J. Richards et al., 2001), we might expect changes in philosophy to be slow and gradual despite abrupt pedagogical changes in response to crises. In addition, unclear messaging surrounding the level of danger and expected duration of the COVID-19 pandemic surely impacted instructors' willingness to change—both in terms of the number, extent, and duration of the changes they would make, as well as the depth to which those changes would be internalized and aligned with shifts in teaching philosophy. If instructors conceptualized the Spring 2020 disruption as a short-term crisis, there would be little reason to overhaul pedagogy or teaching philosophy beyond the immediate semester. Even when there is clear motivation to change pedagogical approaches, other barriers, such as lack of time, energy, or computer skills, can interfere—especially for instructors with young children or limited computer skills (Alon et al., 2020; Malisch et al., 2020).

There is also reason to expect that engineering instructors, specifically, might be averse to certain pedagogical or philosophical adaptations. Interviews by Deters et al. (2020) suggest that the culture of the discipline is likely to be a factor. In particular, engineering instructors are likely to place a strong value on the difficulty of their courses, attributing failures to the lack of student ability and motivation as opposed to pedagogical decisions (Godfrey & Parker, 2010). As argued by Riley (2017), this emphasis on “rigor” has been an important tool for maintaining professional hierarchies. It also reflects a decidedly gendered perception of engineering, placing emphasis on hardness and perseverance as opposed to compassion or support. Interviews with engineering students by Gelles et al. (2020) suggest that instructors’ expression of compassion and empathy, such as leniency and increased accessibility, is greatly appreciated. Yet, in engineering classrooms, fostering and developing empathy among engineering students is much more common than instructors’ expressions of empathy and caring toward students (Strobel et al., 2013; Sundaram et al., 2021). Deters et al. (2020) similarly argued that their own interviews with students demonstrate the importance of compassion and flexibility while illustrating the tension between the practice of compassion and the desire to protect a sense of challenge: to reduce student cheating and/or avoid being taken advantage of. This suggests that the care work, which Hickling et al. (2021) documented as a key motivator for course adaptations among public health instructors, may be expressed in different ways among engineers, if at all. Then, put briefly, engineers were often faced with a conflict between values of rigor and empathy that were not straightforward to reconcile (Skelton, 2012).
1.4 Summary and goals

In light of these findings we would anticipate that the relationship between the pandemic and pedagogical or philosophical adaptation is neither simple nor predictable. The research on pandemic pedagogy generally does not distinguish between pedagogy and teaching philosophy and also tends to focus on specific adaptations instructors made to accommodate the crisis. This study explores pedagogical and philosophical adaptations using instructors' accounts of emergency remote teaching during the Spring 2020 semester. While it is important to document the pedagogical and philosophical changes instructors made, it is equally important to consider the changes that might have been avoided, deemed undesirable, or unnecessary. Exploring these issues in the context of engineering instructors, specifically, will broaden our understanding of how assumptions and values about the nature of engineering education might stand in the way of deeper philosophical changes, impacting successful course adaptation and student accommodations both within and outside of crisis situations.

This study has been guided by the following research questions:

1. What changes, if any, did engineering instructors make to their pedagogical practices and/or teaching philosophies during the Spring 2020 semester's transition to Emergency Remote Teaching?
2. What were the underlying reasons provided for the change or lack thereof?

2 METHODS

This study used thematic analysis to investigate six participants who were part of a larger interview study that explored the impacts of the COVID-19 pandemic on 43 college instructors across a variety of disciplines at four institutions in the northeastern United States. Participants in the full study were recruited via convenience sampling, coupled with a snowballing strategy. Invitations to participate were distributed by Deans and/or Provosts at each institution, and interviewees were promised a $25 gift card. Interview candidates were selected based on information from brief demographic surveys, with the goal of obtaining sample diversity in terms of the institution of employment, age, experience level, rank, adjunct/tenure track status, race/ethnicity, gender, and field of expertise. Additional information about the complete sample group is available upon request from the authors. All procedures of the study were approved by Institutional Review Boards at each university.

2.1 Participants

The participants in this study were selected from the respondent pool based on two criteria: they were engineers by training, and they were teaching engineering courses during the Spring 2020 semester. Six participants fit these criteria. The six interviewees taught a range of introductory, intermediate, and advanced engineering classes, as shown in Table 1. Gender-neutral pseudonyms and pronouns are used in all cases to protect their information. Additional professional duties and personal characteristics are described collectively to protect the interviewees' anonymity. The group

| Pseudonym | Classes taught in Spring 2020 |
|-----------|-----------------------------|
| Ash       | Tenured, teaching advanced undergraduate capstone design and second-year small project class (<15 students) |
| Casey     | Tenure track, teaching advanced undergraduate design class (15–40 students), flipped classroom w/online videos and in-class case studies |
| Alex      | Tenured, teaching advanced undergraduate class (15–40 students), second-year special project, graduate class (<15 students); mostly lectures and online instruction |
| Hayden    | Tenured, teaching advanced undergraduate capstone design, small project classes, and graduate class (<15 students) |
| Ryan      | Tenured, teaching advanced undergraduate lecture-based class (15–40 students) |
| Jody      | Tenured, teaching second-year lecture-based class (41–100 students), advanced undergraduate project-based class (<15 students) |
consisted of five males and one female, whose ages spanned four decades (two each in their 30s, one each in their 40s and 70s). Four were White; two were Asian. Three participants held administrative positions in addition to their teaching duties; one was not active in research while the others self-described themselves as somewhat research active (1), research active (3), and very research active (1). All maintained additional responsibilities as academic advisors, with individuals describing other duties, such as project advising, club advising, university committee service, and service to external professional organizations.

2.2 | Institutional context

All six participants were employed at one small, technologically focused research university with about 2500 undergraduate and 1000 graduate students, referred to as Pine University throughout the article. At the time, engineering majors comprised over half of the undergraduate enrollment, and engineering faculty were 33% of the total 310-member faculty body. The demographics of this institution were, and remain, predominantly White and male: 36% of the overall faculty are female (17% in the School of Engineering), with only 4 Black faculty, 8 Latinx faculty, and 66 faculty from Asian groups. The predominance of non-White faculty in the school of engineering was higher but mostly Asian (48% vs. 25% overall).

Pine University shifted to remote teaching and learning on Friday, March 13, 2020. Initially, the announced shift was to last only 3–4 weeks. Many students had already left campus for the previously scheduled spring break; those who remained were instructed to pack what they needed to continue classes remotely from home. The overall semester timetable was not adjusted. Before classes resumed on March 23 and throughout the remainder of the spring semester, faculty were provided optional “crash course” training via the university’s online education specialists. Institutional support was available for faculty in the form of IT call hours, funds for small technology purchases, and expanded counseling services for students. A pass/fail (P/F) grading option was implemented, which students could elect after learning their final course grades.

2.3 | Data collection

Participants were interviewed between June and September 2020. Interviews were roughly 1.5 h long and were conducted over Zoom in a semi-structured format using an interview guide (Appendix). All interviews were audio and video recorded. Information from the demographic survey was used to inform the interview process and construct Table 1. Interview questions pertained to instructors’ transition online during the Spring 2020 semester, with details about the impact of the COVID-19 pandemic on their work-life balance, teaching philosophy, approach to assessment, course adaptations, and their sense of purpose as an educator. Although teaching philosophies were discussed, we did not review formal written statements. Detailed notes were recorded following each interview. After the first 17 interviews in the broader study were completed, the interview guide was revised slightly to codify ordering changes, phrasing tweaks, and follow-ups we had found useful when discussing teaching philosophy. This practice is consistent with many qualitative approaches, including grounded theory’s advocacy for frequent revision of the interview guide in light of new hunches and information (Charmaz, 2006). The revised interview guide was used with two of our participants from engineering and did not impact the analytical process. Each of the early interviews was conducted by a pair of researchers to establish a sense of respective styles and interests among the four investigators before switching to a mix of independent or paired interviews as schedules allowed. Three interviews described in this research were conducted by two researchers and three by an individual researcher.

2.4 | Analysis

Interviews were transcribed and imported into Quirkos (Quirkos, 2021) for thematic analysis. The process was analogous to the guidance of Castleberry and Nolen (2018), starting with coding interviews. Most codes were developed inductively, but some were created based on the existing literature, such as codes that documented how instructors reconsidered assessment based on Jankowski’s survey (2020) and codes for statements that hinted at different teaching philosophy types described by Beatty (2009). Codes and definitions were maintained in a “living codebook” (Reyes
et al., 2021), a spreadsheet that was continually refined and updated as new data were introduced. Throughout the process, we actively sought to develop consensus and shared interpretations by discussing, clarifying, and reconciling disagreements in how codes were applied and interpreted across our group of four researchers—a strategy consistent with many recommendations for handling team qualitative analyses (Cornish et al., 2014; A. Richards & Hemphill, 2018). A few examples from the project's codebook are presented in Table 2, aligned with the themes they represent. Themes were developed by identifying commonalities across codes and their relationships to one another. Each theme was identified by its commonality across multiple respondents (usually four or more), as well as its strength as an explanation for interviewees’ experiences or behavior (Castleberry & Nolen, 2018). Integral to this process was analytic memoing to clarify conceptual clusters, compare and contrast cases, and develop ideas (Saldaña, 2015). Summary tables enabled us to compare and contrast how each interviewee related to the research questions (Miles et al., 2014). In an effort to establish the validity of our claims and analyses, we also shared an earlier draft of this manuscript with the six participants to seek their feedback. The follow-up communications helped to triangulate the data and confirm findings.

### 2.5 | Author positionality

Like many studies investigating faculty experiences during the COVID-19 pandemic, our team of researchers was collectively experiencing many of the same challenges that were faced by our research subjects. We were, in essence, members of the community we were investigating—all teaching undergraduate-level courses in Spring 2020. We decided to explore this research out of a sincere interest in learning more about how the COVID-19 crisis might be impacting the way faculty approach teaching. This came from our own experiences and conversations, which have created a space for us to interrogate and reevaluate aspects of our own teaching philosophies, our relationship with our students as authority figures versus empathizers, and the need to consider and address vulnerabilities among our students.

We designed and conducted the study collaboratively. As a team, our shared epistemological and ontological foundation is largely constructivist; we view our interview data as the product of social interactions between the interviewee and participant, as opposed to being simple recitations of facts. We acknowledge that interactions were influenced by

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**TABLE 2** Codebook sample showing relevant themes aligned with each research question, including one example code for each theme

| Theme | Example code | Code definition |
|-------|--------------|-----------------|
| Research Question 1 | Theme 1: General accommodations | Relaxed grading | Instances where the participant described shifting due dates for assignments as a general policy |
| | Theme 2: Individual accommodations | Reaching out to students | Instances where participants contacted specific students, not the whole class |
| | Theme 3: Maintaining expectations | Changes avoided | Instances where the participant explicitly did not make changes to their class or avoided providing accommodations |
| | Theme 4: Teaching philosophies guided change but rarely were revisited | Temporary circumstance | This describes the perception that the pandemic was a temporary circumstance, so only minor changes were needed in regard to teaching |
| | Theme 5: Steady foundation | Did not need to make substantial changes | Pedagogical style already worked well, and the transition to online was relatively smooth |
| | Theme 6: Skills with instructional technology | Online teaching learning curve | The level of proficiency in teaching online at the onset of the pandemic |
| | Theme 7: Protecting the validity of grades | Sense of obligation to the field | Instances where the participant felt accountable to the engineering field |
| | Theme 8: Perceived scope of engineering pedagogy | Desire to retain a professional relationship | The participant made it explicit that they are professional, even in the pandemic |
our positions as educators. Although our shared experiences often created an atmosphere of openness and trust, we approached each interview objectively, striving to maintain the position of the researcher as opposed to that of a fellow faculty member. Individually, our diverse experiences enabled us to balance many aspects of the study and provided a broad perspective for analyzing and interpreting data. MJM is a White man whose primary background is in the sociology of health disparities. He is, therefore, an outsider to the engineering community and presented himself as such to the interviewees. He was strongly influenced by his own experiences during the Spring 2020 semester, which had led to a reconsideration of his beliefs around effective evaluation. He was surprised to find that many STEM faculty did not do this and often had good reasons. MW is a White woman who has held careers in both industry and academia, but mainly outside of engineering. This background led her to take a more deliberate and cautious approach to adapting her teaching during the Spring 2020 semester, and she related to the engineering interviewees with whom we spoke. SR is a woman of color whose background is in STEM Education. SR is informed by her previous experience as a high school science teacher and now as a university professor within STEM education. While she works in STEM education, she is outside engineering and clarifies who she is to the participants. Her education and work experiences as an educator biased her to believe that all educators consider teaching philosophy when creating their course structure. JD, also a professor in STEM education, is a White woman whose primary background is in engineering. JD teaches in the school of engineering, and as such, her experiences most closely align with those of the interview participants. Her identity as an engineering faculty member influenced her interpretation of the interview transcripts and findings since much of what was discussed was reflective of her own experiences.

3 | RESULTS

Our analysis of the interviews produced eight major themes that illustrate both the “what” and the “why” of how courses were adapted (Table 2). Our results are summarized broadly in Figure 1 and described in detail in the sections that follow. As Figure 1 illustrates, our interviews uncovered a web of antecedents and outcomes, characterized very broadly in the figure to illustrate key pathways through which course adaptations were devised. While individual interviews revealed various pieces of this puzzle, as a whole, they provide insight into the core research questions of the project—what changed, what did not change, and why?

3.1 | Adapting courses: Changes made, changes omitted

The initial transition online forced our interviewees to reconsider many aspects of their pedagogical practice. In the sections that follow, we describe four themes that address Research Question 1, summarizing the adjustments that instructors made, as well as changes that were not pursued. These themes, taken together, shed light on some of the priorities these instructors established and what they saw as the best way of meeting the challenges of the semester.

![Figure 1](image_url)
3.1.1  |  Theme #1: General accommodation

Four of the six instructors presumed the existence of many unobserved student issues and addressed them with generalized policies. For instance, Casey spoke at length about students experiencing unreliable Internet access and unexpected responsibilities following their return home, as well as an obligation to “be as compassionate as possible with the students because of potential things that are going on at home.” Their primary response was to offer flexible deadlines to all students while retaining their curricular standards—with the expectation that assignments would be turned in eventually. Similarly, Alex shifted content delivery so all students could more easily engage with the lessons:

I heard from a lot of students that they were having difficulties with the Internet, so they had to download the videos to see them, and downloading a 15-minute video is easier than downloading a one hour video. (Alex)

These instructors created generalized, class-wide policies and administered them proactively in an effort to get ahead of looming issues or unreported student struggles. These adjustments were often small—increasing communication, shuffling a deadline or two, offering blanket flexibility on assignments, and/or moving content into an online repository. At times more labor-intensive accommodations were pursued, such as incorporating new COVID-19-related content, switching a live class to a fully asynchronous design, and devising new exercises or assessment mechanisms.

3.1.2  |  Theme #2: Individualized accommodations

Unlike generalized policy changes, individual accommodations were made on a case-by-case basis as issues emerged and typically affected only specific students. These adjustments were more common than general accommodations; in fact, all of our instructors described making some type of accommodations in response to student needs. Instructors typically described reaching out to struggling students or being approached by students directly. For example:

The students who were really struggling either reached out to me via email and told me that they were really struggling, or I could tell because they missed classes. I connected with them almost entirely by email. There was one student, an intern in my office. I knew her well before the class. She reached out with her frustrations, and I felt like ... if she’s frustrated, and I knew how good of a student she was, and how motivated she was, that this is a problem. And so I talked to her on the phone a couple times. But I’d say mostly, it was just email exchanges reaching out, you know, “Hey, you haven’t been in class. What can I do [to help]?” And those often went unanswered, but at least it was an attempt to break ground. (Hayden)

Instructors could not always resolve situations on their own, so they engaged university resources to provide additional support. Ryan, who encountered a great deal of student adversity during the semester, commented:

I had a student who was not doing too well in one of the courses that required the use of a computer ... he did not have a computer that could work for a MATLAB test. So I put them in touch with IT. And they gave him a computer to work with ... But in the other case where the student's home was [struck by a natural disaster], and he did not have anything, ... I think the family is still struggling quite a bit. And his mother had sent an email saying that she's very worried about the textbooks and computers and even things like IDs that got destroyed. I contacted the Dean's Office and IT requesting a spare computer, but there was no response. They would like students to take control of their life, which is okay, from one point of view, but I think there should be more help with things like textbooks. I think that could be easily arranged. So I don’t know what [Pine University's] policy is regarding helping students who need things. But it looks like they do not want to get involved because they probably think that if they start helping one student, they would have to help everyone. (Ryan)

As with the more general adaptations, there was a spectrum of individualized adaptations and accommodations. Minor adaptations included extended deadlines or occasional one-on-one meetings, with outreach efforts limited to emails. Examples of more moderate adaptations included referrals to university services and dropped assignments. At
the end of the spectrum were exhaustive efforts to bring students back into the fold—contacting them on their cell phones (identified via university records) and encouraging them to take a pass/fail grade. A few of our interviews revealed a great deal of exposure to student adversity—sometimes quite severe. Individualized strategies were used to help students as their problems became apparent. In general, however, these changes were not accompanied by statements that suggested a deeper shift in teaching philosophy.

3.1.3 | Theme #3: Maintaining expectations

There were limits to the degree of accommodations that instructors were willing to pursue. Several interviewees expressed discomfort and apprehension with compromising expectations, workload, and perceived challenge level of the course. Casey stated that “... with students, my attitude as well is, like, if a student hasn't met the minimum threshold, they shouldn’t go out and work until they’ve proven that they can meet that.” Given the prevalence of group work in their course, they worried that relaxing standards would exacerbate free-rider problems:

Even though we’re doing this online, you’re having to work from home and meet with your group on Zoom. I’m still expecting the same quality of your report. So my aim was to prevent anyone from thinking, “Oh, I have a chance to slack off.” (Casey)

Casey later suggested that relaxing course standards during the pandemic would introduce problems for professors in future courses:

... It sends the wrong message to students. And when [they] advance to their downstream courses ... they will have a harder time adjusting to a change in expectations if the people teaching those subsequent courses are saying: “Oh no, like I'm not just gonna pass everyone.” There’s a bar. (Casey)

Ryan expressed concerns about the impact on students’ ability to compete in the job market:

If we can teach what should be taught and they should get their degrees and move on with their lives, because ultimately, they will be competing against students 4 years from now, “normal” students, and Covid will be forgotten soon .... These students will have to compete with others who have got all of the right training in the future or in the past, so they have to either prepare themselves or we have to prepare them. (Ryan)

Some interviewees reacted negatively to the university's policy of allowing students to take courses on a P/F basis during the Spring 2020 semester, highlighting tensions between providing fair accommodations versus ensuring what they saw as a quality and rigorous education. In some cases, interviewees expressed apprehension that a P/F option might damage students' career prospects or the field of engineering more broadly:

I think it would hurt the student. Unless the student failed the course, there’s no reason to have a P because then it makes you suspect. A B-student choosing a “P” doesn't make sense to me at all ... I see a lot of P transcripts now and it doesn't create a good feeling when I look at that transcript. (Ryan)

Not all interviewees expressed wariness toward the pass/fail option or relaxing expectations. Jody adjusted grades, to some extent, toward passing: “[Students] needed a C to go to pass/fail. So if they were on the borderline and they were at a C minus, I tended to give them a C.” Hayden similarly acknowledged: “I was sort of loosey-goosey on grading, less rigorous on grading.” In both of these cases, instructors appeared to place less emphasis on grades and the potential professional stakes for their students.

3.1.4 | Theme #4: Teaching philosophies guided change but rarely were revisited

Participants’ explicit responses to questions about their core teaching philosophies often bridged both research questions, simultaneously addressing whether or not teaching philosophies changed, as well as describing how their values
and beliefs about teaching and learning guided the decisions they made. In the end, while most interviewees considered changes to their courses in terms of delivery and all described meeting and accommodating students’ needs as they arose, they rarely described changes in their beliefs about teaching and learning or their duties toward students in light of the pandemic. Rather than reinventing their philosophies, their decisions were framed in terms of existing presumptions and values about pedagogical style, appropriate workloads, and relationships with students.

For example, Jody noted that they felt the pandemic was only a temporary circumstance and that, ultimately, they owed students a specific product:

I don’t think my values changed. But my feeling was that this was an emergency situation … I had to maintain the quality of teaching. It was my job to do that. And … I had to do whatever it took to make sure I gave the students what they paid for. I mean … they’re paying a lot of money to come [here]. And especially the senior class, that was their last semester. And I felt it should be as special as possible … something was taken away from them. (Jody)

Thus, while they did find value in learning new technologies and skills, Jody chose to adjust their pedagogical practice in light of a teaching philosophy that framed their duty to students in terms of an exchange. That framework did not change—rather, their method for executing it did.

Others saw little need for rethinking their beliefs about teaching and learning because they primarily valued developing students’ critical thinking and problem-solving skills, as opposed to specific content. Alex stated:

My point of view is giving them tools. And I think this is true across engineering. We have textbooks, there’s material there to learn, etc., etc. But I think the main contribution that we make in their lives is giving them the tools to solve problems. (Alex)

Again, although Alex introduced minor changes, they did not describe their core teaching philosophy being rattled, as they did not see any conflict or contradictions that justified doing so. Ash, similarly, made adjustments that were coherent with their existing beliefs about effective pedagogy:

I think my job in this particular class was really to be a project manager. In other words, I held them to the timeline. We initially had said that by the end of this class, you’re going to have a report to the president providing the best possible design report you can achieve … And I held them to that, so we set deadlines and I essentially pushed them as much as I could. And some students were able to follow through, the other set didn’t, and then others picked up the slack for them. So I think that was my job, to ultimately get to the end product, right? And so I was the project manager for this. (Ash)

Hayden focused on problem-solving and applied skills for students—adjusting their methods but not their underlying teaching philosophy:

So we adapted a few deadlines. But the basic deliverables were still the same. They had to write progress reports; they had to do a final presentation. They had to write a final report. So all of those things were still the same. Yeah, there was really no change in the deliverables. (Hayden)

Both Hayden and Ash envisioned their instructional roles more as mentors that worked alongside students than as experts that lectured on a particular topic. Their perceived obligations to students were not shifting; instead, those obligations provided them with priorities and values that guided how they approached adapting to the course.

3.2 | Why did the change happen (or not?)

We identified four themes that address Research Question 2, summarizing the reasons behind the adjustments that instructors did or did not pursue. These themes shed light not only on why instructors behaved the way they did, but also, perhaps, more importantly, why they believed it was the best way of meeting the challenges of the semester.
3.2.1 | Theme #5: Steady foundation

Four instructors we interviewed did not make substantial changes to their pedagogical styles because changes were not necessary to continue effective teaching and still achieve established learning outcomes. For example, interviewees who were using a flipped classroom design were able to smoothly translate much of their course content and outline online with few changes:

Personally, I was recording my class in any case, from the beginning of the semester—I record all my classes because I want my students to have access to material whenever they want ... For the past two or three years now, all my classes are administered in such a way that the students can just be at home and attend if they want to. (Alex)

Interviewees who used a problem- or project-based learning approach also described relatively smooth transitions to crisis teaching, largely because their assignment structures (group projects, independent coursework) translated nicely to an online format. Student work was usually done outside of class time, and teacher–student conferences were easily facilitated on Zoom. The end result was positive and generally successful, albeit stressful. However, some interviewees were concerned that the success of their project-based courses might not carry over into an online-only Fall 2020 semester:

I am very happy that we did not start the [Spring 2020] class online. What the two months of in-person class time did was enable me to really get to know the students and to understand how they worked together in teams and seeing them together in teams, how they interacted. (Hayden)

These interviews revealed several flexible pedagogical strategies that lent themselves to online learning while maintaining educational effectiveness.

3.2.2 | Theme #6: Skills with instructional technology

For three instructors, a preexisting grasp of skills that have become essential to online pedagogy played a huge role in easing their transition to online teaching. Some of the most important skills we documented include experience recording lectures, hosting Zoom calls, and customizing a Learning Management System (LMS) site for their course. Skilled instructors were generally more apt to experiment with new strategies in the remote setting. For example, Ash was adept at recording and posting lectures to their YouTube channel for their flipped classroom, enabling them to host live problem-solving sessions in Zoom during regularly scheduled class time. The ease with which they made this transition allowed them to spend more time modifying other course components, such as converting an exam to a workable remote alternative and shifting their grade distribution to put more weight on the student project.

On the other hand, some instructors were hindered by their lack of technological skills. Jody, who had limited familiarity with online teaching skills before the pandemic, described the institution’s response: “... they handed me a little laptop and showed me how to do recordings. That’s all they did. They showed me how to record things I wanted to say ... They didn’t tell me anything about Zoom.” While Jody was able to draw on their colleagues for guidance, they were clear in the interview that navigating the technical barriers was difficult. The implication is that overcoming these challenges would consume time and energy that may have been better spent experimenting with new strategies or reflecting on their teaching philosophy.

3.2.3 | Theme #7: Protecting the validity of grades

Instructors who were averse to changes that involved cutting assignments or relaxing grades, including P/F options, expressed concerns about damaging students’ career trajectories, encouraging laziness, and exacerbating free-rider problems in group work. Instructors further rationalized these decisions in the context of their sense of obligation to the field, professional duty, and the need to provide students with a challenging education that accurately ascertains their professional preparation. Ryan expressed the importance of protecting the interpretation of grades as indicators of mastery, that is, the degree to which students have developed knowledge:
My philosophy is that it’s my duty to educate students, so I have to pick out topics that I know 100% [for] sure are valuable for students to know ... And whether they like it or not, I have to convey that information to them and make sure that they know it for them to pass my course ... As an instructor, I need to know what the students have to learn. And it's my job to make sure that they learn it. And their learning is reflected in the grade they earn. (Ryan)

Casey was concerned that modifying standards would violate a professional duty: “My obligation to the field is to make sure students still learn everything they need to know and have mastery of it at some basic level.” They viewed the P/F policies as a threat to the validity of grades, implying a degree of skill that was not actually attained:

I would have preferred that [P/F] wasn’t given as an option to the students because my concern is that ... In the workforce, they may be hired by people I know, and they know what courses I teach. And ... it's like: “Oh, you got a pass in this. So you must know what you're doing.” But in reality that may have been a C. (Casey)

Alex expressed a similar adherence to duty, arguing that “… There’s an obligation to do it the right way so that people don’t get hurt.” Our interviews commonly exposed this connection between participants’ beliefs about engineering education and the values of the engineering profession, which prioritize the safety, health, and welfare of the public (NSPE Code of Ethics for Engineers, 2022). Alex argued that, fundamentally, grades must reflect the degree to which students have mastered the material; they cannot just be given a default “pass.” When asked about providing a default “C” grade if students had severe technical issues or family crises, they stated:

No .... [I’d] work with the students. I’d get the Dean of students, IT, whoever needs to be brought into the loop, to at least try and resolve the situation. Giving the free grade because technology didn’t work ... is not the right answer. ... [the student’s issue] needs to be fixed. (Alex)

In the end, although they were open to offering accommodations for students, Alex felt that students must adapt to the circumstances.

3.2.4 | Theme #8: Perceived scope of engineering pedagogy

The changes we observed were typically employed to ease students’ abilities to complete course assignments. For example, Jody wanted to “focus on them learning material so that they can go on and they're not missing anything.” Interventions that involved emotionally supporting students or providing material support to students were mostly unmentioned. Although a few of the engineering instructors we interviewed described observing severe student issues, most did not. It is unclear if these issues did not exist or if they simply went unnoticed because students did not come forward or were in a newly asynchronous classroom. This was early in the pandemic; although some students lived in areas suffering from early waves of infection, the region surrounding the university would not see many COVID-19 cases until the coming fall. We also observed a desire among instructors to retain professional student relationships, thereby creating some degree of emotional separation. Ryan maintained: “I kept it fairly professional. In fact, I just wanted this semester to get done and I wanted to cover the topics.” Jody described the perception that processing the emotional and ethical circumstances around COVID-19 just did not fit within engineering coursework:

Engineers tend to be practical ... we have to ... be ready for our job. And we have to understand certain things. And I think that was the focus of everybody. I ... when I think back to my college education, it's not the engineering professors that I remember, it's the liberal arts professor, the person who taught me Shakespeare ... because they talked about human values and things like that ... I don’t have the ability to influence students in that way. (Jody)

These statements exemplify the intersection between course adaptation and teaching philosophy and expose the degree to which pedagogical decisions were guided by instructors’ values and beliefs about the nature of engineering education.
4 | DISCUSSION

This study explored how a small group of engineering instructors navigated the shift to ERT in Spring 2020, deeply probing their competing priorities about changing—or not changing—their courses and their reasons for doing so. Our study was guided by a conceptual framework that distinguishes between teaching philosophy and pedagogy. The discussion is framed around our major findings, highlighting the major challenges instructors faced, the approaches they took to navigate them, and their reasons for doing so. We then discuss how our findings might transfer to similar situations and shed light on future implications in engineering education, as well as potential avenues for future research during and after COVID-19’s long-standing grip on higher education.

4.1 | General versus individual accommodations, profoundly challenging but not transformative

We found that in light of the pressure of the semester, instructors did implement numerous modifications to their courses, although the scope of those changes varied greatly and rarely reflected deep modifications to their teaching philosophy. Instructors tended to either (a) employ general adaptations to course policies to make their course less burdensome on students or (b) handle student issues on a case-by-case basis, identifying and supporting students more directly. Much like Beatty’s (2009) account, teaching philosophies appeared to guide pedagogical change, but these changes fell short of deep shifts in teaching philosophy for most interviewees. While the pandemic offered the opportunity for reinvention, instructors aligned their decisions with existing scenarios, making changes that mainly stayed within the general bounds of their existing teaching philosophies and conceptions. Pedagogical adjustments were largely reconciled with the educators’ desire to maintain a rigorous education and uphold professional standards (see, for example, Trevelyan, 2019). Additionally, the scope of pedagogical changes we observed was largely limited to curricular adjustment. Much less attention was given to creating space for supporting students’ mental health and processing anxieties about the ongoing pandemic. In sum, the pandemic was a profoundly challenging experience for these instructors, but not necessarily a transformative one.

The course changes documented in our study are consistent with previous interviews and survey research on the topic. For example, quantitative surveys of instructors in engineering (Asgari et al., 2021), computer science (Crick et al., 2020), and across all disciplines (Jankowski, 2020) suggest that most made changes to how they assessed students, either in terms of extended deadlines or relaxed standards. Unlike these quantitative studies that considered individual adaptations, our interview findings draw attention to the utility of thinking about course modifications in terms of generalized versus individual responses. This designation may be useful in a survey, especially when trying to predict what sorts of strategies instructors might prefer to use.

Moreover, our study explores the reasons why instructors sometimes resisted creating change. In particular, we exposed some key differences in how engineering instructors approached course adaptations compared to instructors in other disciplines. For example, while Jankowski (2020) found that 75% of respondents from a broad sample of faculty were not worried that assessment changes would negatively impact their institution, more than half of the instructors we interviewed described reducing difficulty and administering P/F grades as potentially damaging to students’ careers and the engineering profession. There was an assumption that engineering education is critical because it prepares students to enter a high-stakes profession—mistakes by engineers can lead to death, injury, and destruction of property. As some of the instructors we interviewed expressed, this view differs considerably from courses with a lower risk of damage, such as an introductory first-year seminar. Future quantitative analyses would likely find meaningful differences in pedagogical decision-making based on the perceived implications of doing so.

4.2 | Approaching change within the boundaries of engineering culture

Our interviews exposed additional examples of instructors’ decisions that were bound by their sense of duty to engineering education and the engineering profession. In general, our findings highlight the difficult balance between flexibility and upholding standards. While we saw instances of “compassionate flexibility” as described by Gelles et al. (2020) and the care work described by Hickling et al. (2021), we also observed limits on how much leeway instructors were willing to give. Our findings mirror those by Deters et al. (2020): students described instructors offering flexibility...
and leniency while simultaneously attempting to counter potential cheating and maintain difficulty. The valuation of “hardness” as a key element of engineering pedagogy is a part of the underlying culture of engineering educators:

This teaching paradigm implied pushing or pulling students to new limits. The strength and ability to “take it” and succeed within this paradigm appeared to contribute to the pride and sense of achievement that students spoke of as an outcome of completing the degree. If the degree was “hard” then they were all the more worthy for having completed it (Godfrey & Parker, 2010, p. 12).

The emphasis on rigor is further documented and critiqued by Riley (2017), who argues that engineering’s focus on difficulty is a mechanism for perpetuating hierarchies among fields (e.g., “hard” vs. “soft” sciences). Riley also suggests that engineering’s fixation on rigor may come at the cost of discouraging students who would flourish in a more nurturing and communal environment.

Riley’s argument is particularly important in light of our interviewees’ expectations that students adapt to the challenges of the semester while also attaining a certain level of content mastery. Studies have shown that a student’s capacity to adapt to the pandemic depended largely on their socioeconomic status (Asgari et al., 2021; Flaherty, 2020). The digital divide is a core factor here, but other issues, such as a lack of safe and affordable housing, unexpected employment or job loss, and limited study space, are also important (Asgari et al., 2021; Beaunoyer et al., 2020; Hargittai & Hinnant, 2008; Williamson et al., 2020). While instructors’ prioritization of professional standards is understandable, there may have been a cost inequitably distributed among the students more severely affected by the pandemic, exacerbating the challenges faced by engineering students from underrepresented populations (e.g., Sheppard, 2020; Tao & McNelly, 2019). This potential expansion of inequalities is especially concerning, given our participants’ wariness toward the P/F option the university offered as a way to counter these disparities. There is some evidence that a P/F grading structure supports collaborative learning and provides a more equitable approach to assessment, particularly in the face of disparate student circumstances, as was seen in Spring 2020 (e.g., White & Fantone, 2010). Our participants were cognizant of the possibilities of social injustice affecting students, but because of their apparently limited exposure to these problems first hand, there was little impetus for leniency.

One way to negate the stigma that students are taking the “easy way out” by electing a P/F grade would have been to make P/F grading standard; that it was optional opened the door to instructors interpreting a “pass” to imply that a student was doing poorly. However, the grading alternatives would not alleviate the hesitation we observed among our instructors who were uncomfortable with the idea that a “passing” grade did not distinguish between an A and a C student. Early studies have indeed shown a connection between P/F grading systems and lowered student performance (e.g., Stucky & Cook, 1976). Moreover, although research is not consistent, some evidence does validate instructors’ general concern that students aren’t learning as much as prior years (Engzell et al., 2021; Shin & Hickey, 2021). A more useful remedy than relaxed grading standards or P/F options can be found in Asgari et al. (2021) suggestion that instructors revise assignments to be take-home or open notes/text, which leverages the unique online setting instead of trying to replicate in-person assessment. These strategies, which may be more effective for assessing students’ problem-solving and critical thinking skills (Bengtsson, 2019), were adopted by several of the instructors we interviewed. Alternatively, shifting to across-the-board P/F grading with clearly specified workloads corresponding to different final grades may enable instructors to simultaneously retain challenge and reduce student stress and uncertainty (Nilson, 2014; Rohe et al., 2006).

Engineering’s cultural underpinnings are also evident in the general lack of instructors’ willingness to provide emotional labor and social support—which some instructors saw as being outside the purview of their work. This is in sharp contrast with preliminary evidence from studies involving a broader range of fields, including our own, which found many instructors going beyond their typical responsibilities to incorporate mental health and self-care in their classrooms, raise funds to provide students with technological equipment, and generally shouldering increased demands for emotional labor—particularly among women and instructors of color (Gonzales & Griffin, 2020; Manierre et al., 2020; Oleschuk, 2020).

While our findings may seem harsh, Atman (2020) illustrates how engineering courses might create a space for emotional support and discussion of crises. The first strategy they suggested includes a brief “check-in” at the beginning of an online class using anonymous digital scales to briefly communalize the mental state of the class. These check-ins could extend into brief sketching exercises where students draw, discuss, and reflect on topics such as how their daily lives had changed. While these potential solutions exist, our study highlights that their implementation hinges on the availability of the technological skills to implement them—meaning instructors like Jody would likely be deterred.
Likewise, because these activities occupy instructional time, they may be avoided by instructors who have concerns about diminishing students' professional development or preparation for subsequent courses. Sufficient institutional support might convince engineering instructors to employ these types of emotional support for their students.

Despite our observation that deep change was rare, it is important to emphasize that our interviewees reported many strategies that reflect successful pedagogical adaptations reported elsewhere to address the emergency transition to online instruction in Spring 2020. For example, many of the behaviors they exhibited align with elements of the four-part model proposed by Marquez and Garcia (2021): “Communication, initiation, reduction, and extension” (p. 4), as well as the three key components of effective teaching and learning during emergencies outlined by King et al. (2021): knowledge (content); delivery (pedagogy); and assessment (outcome). Each of our interviewees did a great deal to increase their communications with students and provide extensions as needed or as a general policy. Some also reduced expectations on assignments; some, such as Casey, cut assignments and/or lectures to make the workload more manageable, while retaining key elements for achieving course learning outcomes. Similarly, the interviewees established mechanisms for frequent student–student and student–professor interactions, retaining a sense of social and teaching presence in the process (Prince & Felder, 2020). Nevertheless, “the need to “just get it online” was in direct contradiction to the time and effort normally dedicated to developing a quality course” (Hodges et al., 2020), and all our interviewees described lessons they would carry into the uncertain F2020 semester.

4.3 | Looking forward

When these interviews were conducted, it was unclear what the future would hold. Though our findings are specific to what we now recognize as the beginning of the COVID-19 pandemic, they do shed light on how engineering instructors might respond in the context of the ongoing pandemic or other instances of ERT. There were, of course, silver linings; for example, Alex described plans to experiment with replacing exams with projects (Prince & Felder, 2020), a strategy Casey had already adopted; Hayden looked forward to leveraging their new web-based teaching skills and enjoying their peers' newfound interest in improving their pedagogical training. Most instructors have, by necessity, honed their technological skills to varying degrees in order to be “online ready” (Davis et al., 2021). In addition, some of the pedagogical techniques and best practices (Felder et al., 2011) we observed among our instructors, such as alternative assessments, project-based learning, and flipped classrooms, are now more widely recognized for their versatility amid changing classroom dynamics that include varying combinations of online and hybrid class formats (e.g., Bashir et al., 2021). The pandemic has solidified the need to adopt, at some level, King et al. (2021) key components (adaptability, creativity, connectivity, diversity, and endurance) for effective teaching during a crisis.

Our study also illuminates the need for changes in the way engineering instructors relate to students. The instructors we interviewed, by and large, prioritized their responsibility to ensure that students left their courses with the knowledge and skills required to excel as they moved on in their coursework or into a career. However, we now know that Spring 2020 was only the beginning of a much larger period of uncertainty. As the pandemic has dragged on, we have seen an increase in the emotional needs of students and a necessary—although difficult—shift in the way all instructors, engineering included, respond. Instructors at other universities may have changed strategies in negotiating tensions between maintaining high standards and showing compassion (e.g., Davis et al., 2021). In Davis' study, the support and advice instructors received from each other within their own and among different departments was instrumental. These collaborations, which enabled them to reflect on their own practices and learn from their colleagues' experiences, had been previously set up before the pandemic and endured through the crisis. As with Atman's digital check-ins (2020), establishing “Communities of Practice” (Davis et al., 2021, p. 3) might be another forward-thinking approach to help engineering instructors develop compassionate classroom skills while still enforcing learning standards. As of this writing, with the “double pandemic of COVID-19 and racial injustice” (Sheppard, 2020, p. 1), the need for engineering instructors to both recognize and be capable of compassionate instruction is very real.

It would be interesting to compare our early findings with instructors in subsequent semesters still impacted by the COVID-19 pandemic, especially given the extended time for planning and institutional guidance relative to the rapid transition to ERT in Spring 2020. Teaching in the following semesters was, in some ways, more difficult, given the complexities of hybrid classrooms and the uncertainties brought about by frequent and sometimes widespread student quarantine. A comparative study might help ascertain the extent to which our observations were specific to engineering professors or if they apply to STEM faculty more broadly. Similarly, a study involving broader demographics may help uncover important differences that our small sample was not capable of exploring, such as gender differences or how
disproportionate childcare duties came into play. Continued documentation of COVID-19's impact on faculty at any
level will be critical not only for guiding effective adaptation to change but also for the historical record and emergency
preparedness in the future.

4.4 | Limitations

The assertions of this study must be considered in the context of several limitations. Our small sample is from a single
institution, and most taught advanced level courses; large introductory lectures and fundamental courses like statics
and fluid dynamics were not represented. The interviews were conducted mainly during the summer following the
Spring 2020 semester. Memories fade; it may be more accurate to describe these interviews as reconstructions of events
rather than factual accounts. Social desirability bias may have shaped their accounts. We also did not collect their
formal teaching statements for comparison but instead relied on their interview statements.

The small sample size and, perhaps more importantly, the lack of diversity at the institution, as well as in STEM
fields more generally, severely limited our ability to provide adequate demographic representation. Specifically, our
study underrepresents Black, Latinx, and female instructors, as well as instructors with young children and adjunct
instructors. It is likely that these demographic groups experienced the pandemic differently, and future research should
incorporate their voices. This limitation is particularly important given emerging research that documents setbacks in
other areas of academic life during the recent pandemic, such as reduced publications among women who are early in
their academic careers (Squazzoni et al., 2021).

It is also important to note that the rural region surrounding this institution, where participants in our study reside,
was not largely affected by the COVID-19 outbreak during the Spring 2020 semester. Instructors living in the midst of
an outbreak zone might have made very different decisions compared to those living in an area where the danger was
perceived as lower. Moreover, our interviews focused on instructors' experiences during what we now recognize as the
initial stages of the COVID-19 pandemic, when instructors were just beginning to adjust to new responsibilities with
respect to accommodating students' emotional needs. A follow-up email from Ryan, received months after their inter-
view, provides some evidence that their thoughts about instructor–student relations evolved with time and perhaps
with a heightened recognition of the pandemic's severity. Ryan had primarily handled student issues individually in
response to problems on a case-by-case basis and expressed several concerns about ensuring that student learning out-
comes would be met despite the pandemic. During the following months, they were tasked with reviewing needs-based
scholarship applications. Ryan relayed through email that:

> The hardships resulting from COVID that the students described in their applications were heart-
> wrenching in many cases. It made me realize that while some of us are lucky to have our lives move for-
> ward relatively unaffected, there are many others in the United States (and surely around the world) for
> whom a seemingly small amount as $500 could make a difference of graduating or not graduating. During
> my review of these applications, I learned that there are many students who cannot afford a daily meal
> because the part-time employment that supported them was canceled, or their parents lost their jobs due to
> the pandemic .... We definitely need to take into consideration these hardships when we teach our courses
> this fall and in the upcoming year. (Ryan)

This increased consciousness toward the severity of the pandemic's effects on students may have provided a clear moti-
vation for change. Ryan was now advocating for a more general, proactive, and compassionate response, stating: “We
definitely need to take into consideration these hardships when we teach our courses this fall and in the upcoming year.” Ryan's transition in thinking highlights how direct exposure to the pandemic's scope and severity might facilitate
reflection about pedagogy, possibly opening a pathway through which teaching philosophies can be reconsidered.
Ryan's thoughts demonstrated that teaching philosophies could take time to change.

5 | CONCLUSION

Our interviews with six engineering instructors suggest that their beliefs and values about pedagogy remained fairly
stable through the emergency transition to online teaching in Spring 2020, but the ways in which they translated those
values into practice changed. Pedagogical changes were either generalized course-wide adaptations to alleviate perceived issues, or more commonly, individual responses to student struggles on a case-by-case basis. Overall, instructors’ decisions to accommodate student struggles were largely constrained by their sense of duty to maintain professional standards, the validity of grades, and their existing technological skills and course design. It is important to consider these findings in context—this study was conducted during the initial stages of the pandemic in a geographical area that was only mildly impacted at the time. Despite holding fast to high standards and professional instructor–student relationships at the start, subsequent experiences and self-reflection in the months following caused at least one participant to recognize the importance of considering students’ personal circumstances as they planned and conducted their classes. Nevertheless, these findings provide valuable insight into how ERT might play out for engineering faculty in the future as other crises occur. They also reveal factors that might need to be considered in upcoming quantitative work, such as the distinction between general and individualized accommodations, the perceived risks associated with reducing the difficulty, and the utility and resilience of existing pedagogical strategies and course designs.

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ORCID

Matthew J. Manierre https://orcid.org/0000-0002-7422-8775
Jan DeWaters https://orcid.org/0000-0002-0435-5971
Seema Rivera https://orcid.org/0000-0002-9800-7299

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**AUTHOR BIOGRAPHIES**

**Matthew J. Manierre** is an Associate Professor in the Department of Humanities and Social Sciences at Clarkson University, 279 Snell Hall, Potsdam, NY 13699, USA; mmanierre@clarkson.edu.

**Jan DeWaters** is an Associate Professor in the Institute for STEM Education and the Wallace H. Coulter School of Engineering at Clarkson University, 120A CAMP Building, Potsdam, NY 13699-5700, USA; jdewater@clarkson.edu.

**Seema Rivera** is an Associate Professor in the Institute for STEM Education and the Department of Education at Clarkson University, Room 313, 80 Nott Terrace, Schenectady, NY 12308, USA; riveras@clarkson.edu.

**Martha Whalen** is a Research Assistant Professor for the Department of Humanities and Social Sciences, School of Arts and Sciences and Adjunct professor with the Reh School of Business at Clarkson University, 268 Snell Hall, Potsdam, NY 13699, USA; mwhalen@clarkson.edu.

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**APPENDIX: INTERVIEW GUIDE**

(INSTRUCTIONS: Introduce yourself and the project, thank them and go through the informed consent form, which should have been provided to them via email before the interview. Emphasize that there are no right answers and that you are happy to clarify any questions or jargon that might vary from field to field.

Remember that this is a semi-structured interview—you may not need to ask all of these questions, and the order they appear here might not be the best order to deliver them in an actual conversation. Deliver questions in your own voice—they do not need to be perfectly verbatim. Be ready to adapt the format and produce follow-ups on the fly to deepen the discussion.)
INTRODUCTIONS/Icebreakers:
Follow up regarding request for syllabus—did they send it? Any questions?

1. Can you tell me a little about your classes? (sizes, goals, student level, teaching style)
2. Think back to when you first found out you would be teaching online. How did you feel about that change?
   a. Have you taught online before? If so, how was this experience similar or different from when you taught a
      planned-online course?
3. Did you keep your course pretty similar to the face-to-face version or did you rethink/restructure your course? How
did you determine what content was in or out of the online course?
4. Did you experiment with any new teaching strategies or ideas? Were there any moments where you were hopeful
   or excited about an idea or approach where it fell apart or succeeded?
5. How has your university supported or guided this pivot to online teaching?
   a. Did you seek help or mentorship from anyone in transitioning to your online course? If so, where did you look,
      or who did you ask for resources to teach online?
   b. What or who was useful for this? How did they help you with this?
   c. What other supports do you need? (e.g., technology?)
6. Did you miss having a physical class?
   a. What was your policy around cameras? Did you find it made it harder to connect with students?
7. What was your work-life balance like before you switched to online teaching? How did that change after
   transitioning online?
   a. What other responsibilities do you have while working from home?
   b. What is your workspace like at home? How is it different from your office?
8. How has the coronavirus affected your students?
   a. What did you do in response to learning about this? Any concrete examples?
9. How open were you to your students about the challenges of your own life?
   a. (Clarification) In other words, did you talk about it being hard to social distance, struggling to get work online,
      or revamping the syllabus (e.g., trying to relate with them and empathy) or did you keep those difficulties to
      yourself?
10. Think about your relationship with your students—on a spectrum from really personal, a friend, even, to distant
    and professional—where did you fall before COVID? Why do you land there?
    a. Did this change? that is, Did you ever feel a tension between your role as a professor (and the job it entails) and
       your desire to relate to or empathize with students?
    b. Were you comfortable with this degree of formality?
11. Since transitioning online, did you ever make any attempts to reach out to or connect with students that you might
    not have?
    a. Why? What motivated the outreach? How did you hope students would respond versus how did they actually?
12. Can you tell me how you felt about grading and evaluating students during the Spring semester after transitioning
    online?
    a. How did you accomplish “fairness” in this task?
    b. Did this differ from your usual approach?
    c. Were there any standards that you felt that you were no longer comfortable holding students to?
13. Our school switched to a pass/fail grading model—did yours? How did you feel about this? Did it factor into your
    teaching process?
14. Was there any point where you felt like your students were “testing” or taking advantage of your generosity or flexi-
    bility? How did you deal with this? Did you learn anything or revise any of your practices because of it?
15. In your mind, what is your job as a professor? Follow up: Do you enjoy teaching?
16. What do you feel are your obligations to your students? What do you “owe” them at the end of the semester? What
do you consider to be a sign of “success” for your students at the end of the semester? How does this relate to your
    teaching philosophy?
17. Did having to revamp crisis teaching clarify your priorities—not just for content but also for teaching in general?
    a. What do you hope to impart or model?
    b. Were you able to achieve something that reflected those priorities in the end?
18. Are there any lessons that you have learned about being an educator (i.e., the role, less the actual act of teaching) from this?
19. Why is what you teach important? Did that belief change as you thought about the fact that you would be teaching in the midst of a pandemic? And if so, did that change over time and how?
20. Is there any overlap between what you teach and what is going on in the world currently, in the midst of the COVID-19 pandemic?
   a. Have you tried to bring current events into your teaching since we have transitioned to remote teaching?
21. Do you feel that students value what you teach more or less than when the crisis happened? What gives you that impression?

(Potential follow-ups)

   a. Do you worry about not adequately preparing your students with the skills/content they should be learning?
   b. Is the world situation too dire for you to feel right teaching (topic) as a top priority in their lives?
   c. OR, Is your course (attending, working on, etc.) a valuable escape for you/your students from what is going on in the world?

22. Were you happy with how things turned out?
   a. What worked? What did not? If you could do it again?
   b. How would you evaluate your efforts by the end of the semester?
23. What are your thoughts about if you had to do this transition online all over again in the fall?
24. Has there been any silver lining here (teaching or otherwise)? Have you developed any new skills or tricks that you hope to carry over into the future?
25. Is there anything you have been hoping to say or that is really important that we have not been able to touch on yet?

(Before you end the interview, thank them and ask for verbal confirmation that the information they provided on the demographic survey is accurate so that there will not be a problem getting them their gift card.

Thank them, and ask if they are ok with you contacting them in the future if any follow ups or clarifications arise.

Ask them if they know anyone who might be interested in participating in the project and if we can name them as a referral when we reach out directly.

End the interview at this point. You are welcome to answer any questions that they might have as you wrap up. Once done, end the recording, and transfer files to the appropriate people or storage repositories for encryption and transcribing. Send them the gift card and thank you email within 24 h if possible.)