education sciences

MDPI

Article

# Compassionate Flexibility and Self-Discipline: Student Adaptation to Emergency Remote Teaching in an Integrated Engineering Energy Course during COVID-19

**Laura A. Gelles [1,*], Susan M. Lord [2], Gordon D. Hoople [2], Diana A. Chen [2] and Joel Alejandro Mejia [2]**

1 Erik Jonsson School of Computer Science and Engineering, University of Texas at Dallas, Richardson, TX 75080, USA
2 Department of Integrated Engineering, University of San Diego, San Diego, CA 92110, USA; slord@sandiego.edu (S.M.L.); ghoople@sandiego.edu (G.D.H.); dianachen@sandiego.edu (D.A.C.); jmejia@sandiego.edu (J.A.M.)
* Correspondence: laura.gelles@utdallas.edu

Received: 30 September 2020; Accepted: 25 October 2020; Published: 28 October 2020


**Abstract:** The global pandemic of COVID-19 brought about the transition to Emergency Remote Teaching (ERT) at higher education institutions across the United States, prompting both students and the faculty to rapidly adjust to a different modality of teaching and learning. Other crises have induced disruptions to academic continuity (e.g., earthquakes, hurricanes), but not to the same extent as COVID-19, which has affected universities on a global scale. In this paper, we describe a qualitative case study where we interviewed 11 second-year Integrated Engineering students during the Spring 2020 semester to explore how they adapted to the transition to remote learning. Our results revealed several student challenges, how they used self-discipline strategies to overcome them, and how the faculty supported students in the classroom through a compassionate and flexible pedagogy. Faculty members showed compassion and flexibility by adjusting the curriculum and assessment and effectively communicating with students. This was especially important for the women participants in this study, who more frequently expressed utilizing pass/fail grading and the personal and gendered challenges they faced due to the pandemic. During this unprecedented crisis, we found that a key element for supporting students' well-being and success is the faculty members communicating care and incorporating flexibility into their courses.

**Keywords:** emergency remote teaching; compassion; engineering; student experience; undergraduate students; qualitative research

## 1. Introduction

The outbreak of the novel coronavirus around the world has dramatically affected all aspects of daily life and caused institutions of higher education to move towards remote learning. On 6 March 2020, the University of Washington became the first university to cancel in-person classes [1]. On 11 March 2020, the World Health Organization designated COVID-19 a global pandemic [2]. In response to this and other data, institutions of higher education shuttered their universities and announced mandates to transition to online-only education to protect the health and safety of students, staff, and faculty. Study abroad programs, university events, sports, graduation ceremonies, and other large gatherings were cancelled as the general public was advised to shelter in place and to limit or remove their contact with individuals outside of their household. Students were required to rapidly respond to

these mandates by relocating from campus and preparing for remote learning with little time to adjust, sometimes at great personal or financial hardship. As students physically relocated, university faculty, staff, and administrators adapted their in-person curriculum to Emergency Remote Teaching (ERT) while they sheltered at home.

Institutions have used multiple terms (e.g., online learning, remote learning, distance education) to describe the rapid transition to teaching remotely during quarantines and stay at home orders (i.e., ERT). However, these different learning modalities such as online learning typically allow for planning, student autonomy and flexibility, establishing teaching presence, care in developing digital literacy and netiquette, managing student expectations, and resolving technical difficulties beforehand [3]. The primary differences between ERT and online and remote learning are that ERT is intended to be temporary, is enacted in response to a crisis, requires a rapid response in order to develop and implement adjusted course content, and does not offer curriculum in its intended modality [4]. While online or remote learning may be offered in similar ways and with similar technologies to those used in ERT, unlike ERT these classes were purposively designed to be online and/or remote. Because ERT uses similar tools and methods to online or remote learning, some faculty members have experience with aspects of online teaching or remote working tools, such as learning management systems (e.g., Blackboard) and video conferencing applications (e.g., Skype, Zoom) [5]. Often, universities already have these tools at their disposal, with some faculty members choosing to utilize them in their in-person classes to support in-person learning. However, because of the crisis, even faculty members who were highly resistant to these technologies have had to use them to finish instruction for the Spring 2020 semester. Additionally, the faculty quickly discovered that ERT has different challenges than planned online learning or teaching in-person (e.g., constrained resources). While universities offered what resources they had to help faculty adapt to the technical aspects of their new reality, they could not completely prepare them for the pedagogical challenges that result from teaching remotely during a crisis.

While faculty members were quickly trying to pivot to ERT, students were simultaneously affected by corresponding difficulties. Some students had limited or inadequate access to resources such as computers, webcams, reliable internet, and learning spaces free of distractions [6]. Students faced job loss or housing insecurity, or were sent home to unsafe and unsupportive homes [7]. Other students were in completely different time zones and could not attend class synchronously. Many found remote learning impersonal and challenging. During this time, students still needed resources such as academic advising, career guidance, and mental health support, but there may have been inadequate technological or human infrastructure to scale these resources to an online environment [8]. Without informal in-person interactions between their peers, students were reliant on the sometimes limited and confusing communication from the university, university staff, and their professors for any information regarding how the remainder of the Spring 2020 semester would be handled, how they would be assessed, and any resources or flexible grading policies (e.g., pass/fail grading) that could benefit them.

These are not novel issues, but they are now occurring at an unprecedented scale and exacerbating disparities that were too often ignored when all students were expected to be within a classroom. As COVID-19 has revealed and heightened existing inequities within society, so too are these imbalances magnified during the global pandemic within higher education. Solutions for providing resources and accommodating students already exist, but barriers can inhibit students from accessing these resources which are exacerbated by the crisis. For example, students with (dis)abilities are able to make accommodation requests for equal access to education (e.g., given more time to complete exams, lecture notes); however, barriers such as stigma, discrimination, lack of awareness of resources, and unwillingness to accommodate students can still prevent students from accessing these resources [9]. A report by the National Center for Learning Disabilities states that only 17% of college students with (dis)abilities reported utilizing these resources [10]. After the Spring 2020 semester and rapid pivot to ERT, disability advocates are questioning why remote learning requests were not accommodated for

students with disabilities before the pandemic [11]. As with material resources, students also needed more attention, clear communication, and care during the crisis. The crisis and abrupt shift to online learning have magnified these issues to the point that they must be addressed. How, then, can students and faculty members adapt in this time of crisis?

In this paper, we sought to investigate the ways in which students and faculty members responded to the transition to ERT within a case study of a second-year undergraduate engineering class. We describe the approach the faculty of IntE took in response to the emergency, the pedagogical adjustments intended to make teaching and learning more effective, the compassion-driven approach to education adopted by the department, and the ways in which students responded to these abrupt alterations.

## 2. Literature Review

### 2.1. Crisis Management and Reaction in Higher Education

While COVID-19 caused a major large-scale disruption to higher education, it is not the first time a crisis has prompted the shift to online learning. Academic continuity disruptions have occurred as a result of natural disasters such as hurricanes [12–15], earthquakes [16–19], large-scale student protests [20,21], and war and conflict [22], which have also resulted in a temporary and sometimes long-term shift to online and remote learning. While student and university employee responses to pandemics such as H1N1 influenza virus (also known as "swine flu") have been studied [23], class cancellation has been advised [24] and academic continuity plans created which advise online teaching [23]; these outbreaks have not been as severe as COVID-19 in both the magnitude of people who are affected and how long the crisis has lasted. Crises with an extensive spatial and temporal extent inherently have more uncertainty as to when there can be a return to normalcy and thus can severely disrupt academic continuity [25]. While, in the past, pandemics such as H1N1 have only caused weeks of disruption on regional scales, the current global pandemic has affected entire nations for months with no clear end in sight [26] and have been accompanied by state-mandated transitions to online or remote learning.

Several themes have emerged within the literature about higher education responses to these disasters and their transition to online or remote learning. These include the rapid adaptation of e-learning/online learning [17,18], the importance of clear and transparent communication from the university to students [12,13,16,18,21], issues of equity and ethics [21], faculty care (e.g., emotional support) for students [12,15,21], and students showing empathy (i.e., compassion) for their instructors [16,25].

### 2.2. Higher Education Rapid Response and Adaptation to Crisis

Hurricane Katrina was a category 5 hurricane that struck the Mississippi/Louisiana Gulf Coast in August 2005, causing over 1200 deaths and billions of USA dollars in damage. Many people were forced to evacuate or relocate in the aftermath of Hurricane Katrina, including an estimated 100,000 college students after the continuing crisis also caused long shutdowns on college campuses [27]. Universities in the area quickly responded to the crisis, prioritizing the safe relocation of students, clear and frequent communication, and enhanced assistance from information technology (IT) personnel [19]. In response to students not being able to attend in-person classes in affected institutions, a nationwide effort of a consortium of 153 higher education institutions, the Southern Regional Education Board, and the Alfred P. Sloan Foundation provided online education to the thousands of students who had been displaced by the disaster by creating the Sloan Semester project [15]. This team had made prior preparations in the event that a pandemic such as the H5N1 influenza, also known as the avian flu (which affected China during 2005), caused a campus-wide shut down. The Sloan Semester began offering classes online to affected students 16 days after the levees broke due to Hurricane Katrina [15]. The lessons learned from this rapid adaptation include: developing or adapting existing delivery

frameworks for online instruction (e.g., learning management systems); constantly communicating to students, faculty, and staff using multiple paths of communication such as email, text messages, or social media; and prioritizing the greatest issues first [28]. A limitation of rapidly responding to a crisis, however, is that initiatives such as the Sloan Semester focused on the logistical challenges of how to implement ERT rather than effective pedagogy during the crisis. Despite overcoming many logistical implementation issues, the students enrolled in the Sloan Semester still struggled with access to resources such as power and internet, had limited time and energy to focus on classwork, navigated trauma and mental health issues, and dropped out of classes [29].

### 2.3. Importance of Frequent and Transparent Communication

The 2011 Great East Japan Earthquake struck the Pacific coast of Tōhoku and caused a tsunami and nuclear accidents, including level 7 meltdowns at three reactors in the Fukushima Daiichi Nuclear Power Plant. Gómez describes the reaction of international students at the Engineering School of Tohoku University to this event [16]. First, the university immediately sought to confirm the safety of their students, however in the aftermath of the earthquake, international students were left with tenuous shelter and resources and many decided to return home. These students primarily relied on non-university sources of information such as family, friends, and people of their own nationality to inform their decision. After the fact, students reported that the most negative aspects of the university's response were slowness in decision making and providing information. When finally returning to the university, the students' discussions with professors were the most important factor in deciding their return date. Professors offered the students a sense of security and reliable information. On the other hand, publishing important information only on websites was not enough to inform students [16].

### 2.4. Issues of Equity When Transitioning to Emergency Remote Teaching

In South Africa, recent large-scale student protests about the lack of accessibility to higher education (exacerbated by high tuition fees and exclusionary policies) and demands to decolonize the curriculum caused disruption at universities for two years [20,21]. In response to the continuing disruption, universities adopted blended/online learning, amplifying the issue of inequity as not all students had access to the resources necessary for online learning or were not fluent in digital literacies [21]. In response, online/blended learning was perceived as undermining student protests. Likewise, in other crisis events such as Hurricane Katrina, access to reliable internet has also been revealed to be an equity issue [30]. This has been a critique of online learning as a form of distance learning where access is restricted by internet and computer resources [31]. Though online education could potentially support marginalized communities and provide wider access to education, too often individuals who face equity issues within traditional educational settings also face similar issues within online education [32]. The continued lack of equitable access to educational tools and technologies exacerbates the already-existing inequity gap.

### 2.5. Faculty and Students Showing Compassion and Care During Crisis

In the event of a crisis prompting a transition to ERT, both faculty and students encounter uncertainty and the need to adapt. Students bear the responsibility of adjusting to and being successful in this new modality of learning and quickly adopting and navigating a panoply of new applications and technologies for communicating and learning that are required across multiple classes. At the same time, faculty members are responsible for quickly redesigning and adjusting curriculum, learning new technologies and programs, and learning how to best teach in the new virtual format where students do not react or respond in the same way as before [21]. During times of crisis, both faculty and students require support in managing these forced transitions [18]. Showing compassion and care for students can be more difficult when there is physical and social distance.

Compassion is recognizing the suffering of others and taking action to help. While empathy and compassion are similar, compassion may be thought of as an aspect of empathy that includes action and

response to having empathy. Empathy has a cognitive component of knowing how someone else feels, an emotional component of feeling what the other person is feeling, and then a responding component of showing empathy (i.e., compassion) [33]. The individual showing compassion understands the emotional state of others, feels their emotion, and is moved to action based upon those emotions and awareness [34]. To show that they care, instructors have to be attentive and receptive to the student by first listening and reflecting on their needs and then responding positively to the student's expressed need or, if that is not possible, in a way that maintains the caring relation [35]. Faculty have shown care during ERT through the way they communicate with and respond to students. Specifically, they have elicited frequent feedback, responded to curricular and personal concerns, offered more choice and autonomy in assessment, utilized applications that were more accessible, and repeatedly updated and adapted course material based on student feedback [21]. Students relied on and trusted information provided by faculty during times of crisis and, despite the issues they faced, expressed that they understood that the university did the best they could in the situation [16]. Even on a smaller scale, where a personal situation prompted ERT for a week, students showed compassion, empathy, and forgiveness for their professor when information was communicated clearly [25].

### *2.6. Emergency Remote Teaching during COVID-19*

In a survey of 897 faculty members and administrators at 672 U.S. higher education institutions and their response to COVID-19, faculty members reported having to alter their exams or assignments (64%), lowering the amount of work given to students (46%), adjusting their expectations for students (48%), and allowing students to choose pass/fail grading (49%) [5]. Another study of over 1000 undergraduates who went online due to COVID-19 found that students "struggled to stay motivated and missed receiving feedback from instructors and collaborating with fellow students" [36] (p. 3). An example specific to engineering was the University of Georgia's Engineering Education Transformative Initiative's (EETI) recently published reports for their National Science Foundation (NSF) grant for Rapid Response Research (RAPID) on their findings on student and faculty experiences during ERT [37,38]. They found that, while both students and staff reported difficulties working from home, faculty members and staff were adapting well to the crisis by exercising agency, while undergraduates self-rated their experiences as highly negative and reported that they were treated with indifference and disrespect by people in power [37]. Students also reported feeling ill-prepared for the transition, having difficulty communicating with professors, and how impersonal instruction was. In response, the authors recommended that the College of Engineering's instructional focus should shift from being rigorous to being compassionate [37], and that compassion could be manifested through flexibility [38]. They recommended ways for faculty members to show compassion, including eliciting student input about course workload and assignment due dates and changing how students are assessed (e.g., flexible projects with autonomy instead of exams) [38].

Because of the quick pivot, the emergency context, and ongoing uncertainty, learners enrolled during the Spring 2020 semester had no choice but to deal with remote learning in contrast to making the decision to take an online class [39]. Institutions had contextually specific reactions and adaptations to the global pandemic during the Spring 2020 semester, and the lessons learned echo the themes of other crisis responses. Specifically, preliminary findings point to the need for compassion, care, and empathy for students during crisis situations [5,36,37,39,40].

## 3. Methodology

We selected a case study as the qualitative methodology for this study. Case studies are used to explore a phenomenon within a bounded system so that an in-depth understanding emerges from examining an individual, bounded case [41], and take into consideration the "particular idiosyncrasies of the institution, its resources, teachers and students, as well as its overall culture" [42] (p. 191). While institutions of higher education across the U.S. experienced the phenomenon of COVID-19 and the rapid implementation of ERT, based upon the literature on crisis management in higher education

we believe that the particular way faculty members and students adapted within the department of Integrated Engineering at the University of San Diego (USD) within the United States is a compelling case that it is important to highlight. Given the disciplinary culture of engineering, which is highly technical, emotionless, rigorous, meritocratic, and depoliticized [43,44], we wanted to provide a counter to traditional engineering pedagogy that is sociotechnical and grounded in compassion [45–48]. Given the large number of engineering students that have reported negative reactions to ERT during COVID-19 [36,37], we describe an approach that provides valuable insights about the culture of care and compassion not only during uncertain times but permanently in engineering education.

### *3.1. Purpose*

The purpose of this case study was to illustrate what engineering faculty can do to support students during ERT and, correspondingly, what methods students used to adapt in this crisis. In doing so, we aim to provide engineering educators with insight into what they can do to support students in their classroom as the global pandemic continues to disrupt higher education. As with all case study approaches, the results are not generalizable to all engineering classrooms, however the lessons learned from this case can be adaptable to many different contexts [42].

### *3.2. Case Study Context*

For this study, we explored the case of a single second-year undergraduate engineering class, "An Integrated Approach to Energy", within the Integrated Engineering (IntE) department at USD, a private Roman Catholic institution in the western USA where engineering students receive a BS/BA and take the same liberal arts core curriculum as all other undergraduates. USD has a high tuition and small class sizes, and students expect to receive personalized attention from their instructors. The university strives to develop ethical leaders and compassionate citizens with a global perspective who will make a positive difference in the world. We have included a description of the context of our university's response to COVID-19 and transitioning to remote teaching, IntE's response and reactions, and the response of the faculty member who taught the class that bounds this case study.

#### 3.2.1. University Response to COVID-19

The leadership at our university, like most across the USA, struggled to respond to the COVID-19 pandemic during the Spring 2020 semester. Constantly evolving information from the Centers for Disease Control and Prevention (CDC) and other federal and state agencies required rapid decision-making, prompting the creation of the university's COVID-19 Action Team, which did not include faculty representation. A timeline of relevant events before and during the transition to ERT at USD is provided in Figure 1.

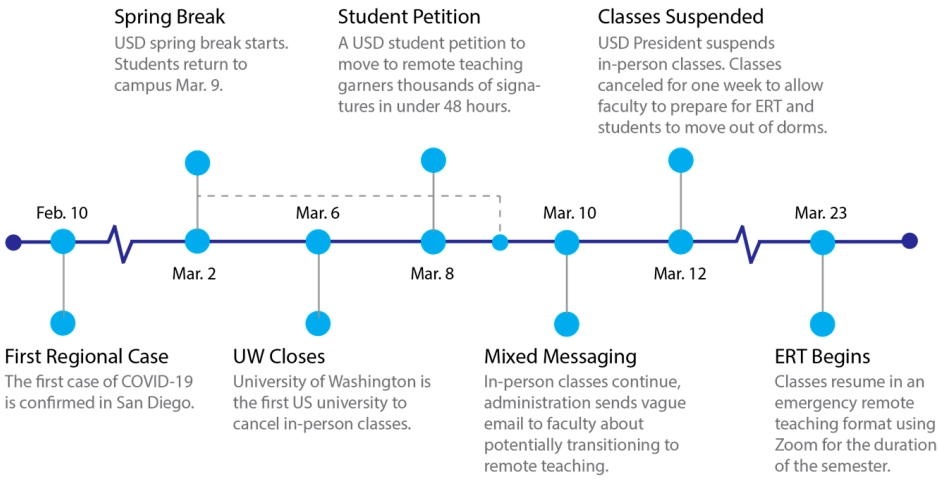


**Figure 1.** Timeline of the USD's response before and during the transition to ERT due to COVID-19.

Overall, communication from the administration was sometimes unclear. In early March, the lack of detail and quickly evolving messaging was confusing, contradictory, and heightened the anxiety of faculty and students. Further, official communication from the university through emails and a virtual presidential forum focused on the bleak potential financial implications and a deficit framing of future student enrollments' impact on the university. The next major issue our university grappled with was the ambiguous implementation of the pass/fail (P/F) option for course grading for the Spring 2020 semester (note that our university traditionally had letter grades of A, B, C, D, and F for most classes required for graduation). In the Spring 2020 semester, if students chose "P/F" and received a grade of "pass" for any class, they received credit towards degree requirements for graduation. If they received a "fail," they would not receive credit and would need to repeat the class to satisfy degree requirements. Many students were concerned that taking a class with P/F would look bad to employers or were unsure how it would affect scholarships. Compounding on this, inconsistent messages were given to students by faculty (mostly due to the limited information received by the faculty), which led to considerable confusion and anxiety. Some students felt pressured into choosing P/F by faculty members, while other faculty members stigmatized the P/F as failing.

#### 3.2.2. IntE's Response to COVID-19 and ERT

IntE is a new department within the School of Engineering which includes four untenured faculty and one tenured faculty, who is the chair of the department. The faculty include one Asian woman, one Latino, two White men, and one White woman. This department reframes engineering as a sociotechnical endeavor, places a high value on inclusion in engineering education, and deliberately fosters strong relationships with students to support the academic and personal success of their small student population (the largest cohort being the sophomores described in this paper, which has 18 students). During the week when classes were cancelled to aid in transitioning to ERT, IntE quickly established an online community of practice. The department created new communication pathways to meet both formal and informal, social, and professional needs. They also held sessions to practice new technology such as Zoom to learn together how to better facilitate remote teaching. The department was intentional in their student facing efforts, creating informal and low-barrier ways for students to access them in ways that simulated "popping into office hours" when on campus. The IntE faculty members presented a united front by utilizing the same technologies (e.g., creating a Slack workspace for each of their classes for students); utilizing existing structures that students were familiar with prior to ERT (e.g., Blackboard); and collaborating on a survey to assess students' remote learning resource needs (e.g., access to internet and webcams), logistical challenges (e.g., different time zones), and well-being (e.g., how they were coping). Concurrently, this also allowed a platform for students to express their concerns and voice their questions before the official start of remote learning. Based on the results from this survey, the IntE faculty developed a comprehensive plan to ease students' transition to remote instruction.

#### 3.2.3. GENG 294: "An Integrated Approach to Energy" Response to COVID-19 and ERT

When the transition to ERT was made official, the course instructor (GDH) shared a remote learning plan for his course, "An Integrated Approach to Energy", with his students, which included revisions to the course syllabus, expectations, and procedures for communication. The class was structured with an active learning approach that incorporated groupwork in breakout rooms that GDH could monitor and unobtrusively interact with over Google documents. GDH was flexible in response to the difficulties the students faced during the pandemic. He removed and adjusted the course requirements (e.g., attendance) and provided access to course content both synchronously and asynchronously. He checked in with students to see how they were doing both formally (e.g., surveys, reflections) and informally (e.g., Slack). Through daily student reflections, the students revealed the incredible pressure they were under (e.g., they had family members who were first responders, had lost their jobs, or had passed away). In response to students feeling overwhelmed, he changed his no late

assignments policy and allowed more time to complete exams. When students were unsure whether to utilize P/F grading due to the confusion and stigma created by the university, GDH spent class time unpacking what the P/F option meant and clearly communicated students expected grade at the end of the semester. He encouraged students to choose that option if it would benefit them in any way.

### 3.3. Researcher Position in the Case

The authors of this study consist of four faculty members from the Integrated Engineering department (SML, GDH, DAC, JAM) and the first author (LAG), who is a postdoctoral research associate hired under an NSF Revolutionizing Engineering and Computer Science Departments (RED) grant that the school of engineering received to develop "Changemaking" engineers by redefining the engineering canon as sociotechnical [49]. LAG was situated closely to the IntE department both in proximity (e.g., housed in the same building before the stay at home order) and in curricular and research interests [50–52]. As such, LAG's expertise has been utilized to conduct observations, interviews, and focus groups for IntE faculty. As a postdoc, the first author did not teach any classes during ERT, but rather observed how the IntE department prepared and adapted to ERT and interviewed students about the class and their response to the COVID-19 pandemic. Coincidentally, the new communication pathways created by IntE in response to ERT also facilitated easier connection and the inclusion of LAG.

For the class, "An Integrated Approach to Energy", the students had been formally introduced to LAG's presence by the instructor on the first day of the Spring 2020 semester as a researcher who would be conducting classroom observations. LAG was in the classroom on a weekly basis until the transition to ERT. This presence in class along with the instructor acting as a gatekeeper to the students about her presence and role allowed for a measure of trust, credibility, and rapport from the students [41,53]. This initial trust was further cultivated into rapport during interviews so that students saw the researcher as an empathetic listener rather than as a detached evaluator [53].

### 3.4. Participants and Recruitment

Participants were purposively recruited [54] in April 2020 for semi-structured interviews using convenience sampling [41], based upon being enrolled in "An Integrated Approach to Energy" in the Spring 2020 semester. Convenience sampling was utilized because research interviews were already being conducted for research on other aspects of the class [52]. The instructor informed the class over Zoom about the research study and provided them with a link to a Google form where they could sign up to participate in a research interview. The first author individually contacted the respondents who wished to participate through email and scheduled Zoom interviews. After the conclusion of all scheduled interviews, the participants were compensated with a $50 Amazon gift card.

Eleven second-year undergraduate engineering students out of the 18 in "An Integrated Approach to Energy" during the Spring 2020 semester participated in this study. A summary of these students using their pseudonyms is provided in Table 1. Additional demographic information within the table about the students was elicited through a voluntary survey using Google forms or described within their interviews.

### 3.5. Interview Procedure

The interview protocol was initially piloted with a fourth-year undergraduate engineering student researcher who was also experiencing ERT at the time and provided relevant feedback. Questions about students' response to COVID-19 and ERT were added to an existing interview protocol due to the timing of the ERT. Interviews were semi-structured and split into two sections; the first was about their experiences in the GENG 294 class and the second part was specific to their experiences of COVID-19 and remote learning at their university. The second part of the interview was structured to first allow the participants to say anything they wanted to or "vent" about their experiences to develop rapport and promote a therapeutic effect by providing participants with an active listener who was

nonjudgmental, neutral, and did not interrupt [55,56]. The first author conducted all semi-structured interviews over Zoom in response to the pandemic and stay at home orders. The participants were already familiar with using Zoom because it was utilized for ERT. Interviews were recorded using Zoom's built-in recording function with an audio-recorder as a backup. Interviews were transcribed using TranscribeMe!, an online transcription service.

**Table 1.** List of participant pseudonyms, gender, and whether they utilized pass/fail grading.

| Pseudonym | Gender | Utilized Pass/Fail |
|---|---|---|
| Chandler | M | Yes |
| Clara | F | Yes |
| Gloria | F | Yes |
| James | M | Did not disclose |
| Lexie | F | Did not disclose |
| Luigi | M | Yes |
| Peter | M | No |
| Rachel | F | Yes |
| Raymond | M | Did not disclose |
| Rebecca | F | No |
| Tito | M | Did not disclose |

### 3.6. Ethics in Data Collection and Analysis Procedures

This study was situated in a larger research project occurring with the class. Informed consent was obtained at the start of the semester when the class was observed in person. Measures to ensure the confidentiality of participants were utilized throughout data collection and analysis [41]. The pandemic required several unanticipated changes not covered in the initial informed consent, such as interviews being conducted over Zoom. Before the interviews, the students were briefed about the structure of the interview, informed that their participation was voluntary, informed that they had the right to not answer questions and to rescind participation at any time, and informed that participation had no effect on their grade. The participants were made aware verbally and visually (by the recording icon in Zoom) when and how their responses were recorded and when the recording was stopped.

Pseudonyms were assigned at the start of the semester for classroom observations to preserve anonymity [57]. Because this is a narrow case study, the participants were also given the option of checking any direct quotes used in the manuscript to ensure that they were not misrepresented or overly identifiable [58].

### 3.7. Data Analysis

Interview data were qualitatively coded and thematically analyzed using memoing, concept mapping, and multiple coding methods [41]. After each interview, the first author wrote a summary and reflective memo. Memoing was used as a critical reflective process to describe the emergent patterns, themes, and concepts that arose in the analysis [59,60]. Following each reflective memo, the interviews were read in their entirety several times while utilizing concept mapping to visually analyze complex emergent phenomena [61,62]. This concept map was iterated several times as the data was coded. Open coding was used to explore the data in order to remain open to multiple interpretations and nuances in the data [59]. This coding was exploratory, utilizing descriptive and process coding to provide a detailed inventory of student responses and actions [59]. In combination with descriptive coding, concept mapping, and memoing, process coding allowed for the inclusion of actions in the data that can help explain how events dynamically unfold and evolve [63]. This was important to the coding process because student participants are not passive recipients of ERT but rather dynamic actors in defining how they responded to ERT and the global pandemic.

After initial coding, a codebook was developed by categorizing and reorganizing the concept map into larger categories with codes and subcodes. These categories and codes were discussed iteratively

among the authors to provide different perspectives and expertise in the analysis. This process refined the codebook. The data was recoded with the refined codebook using Dedoose, an online application for collaboratively analyzing qualitative data. The results of these coding processes were then thematically analyzed to further winnow codes and categories into larger themes that reflect a more nuanced and summarized meaning than individual codes [59]. The results of this thematic analysis were triangulated with the undergraduate researchers [41], who were third-year IntE students who also experienced remote learning within the context of the university and the department.

### 3.8. Limitations

This study was limited in that it was conducted on a small population at a private institution within the Western USA and the results cannot be generalizable to all undergraduate engineering students. Larger engineering departments at public institutions will have different challenges, but some of the lessons may be transferable and adaptable to their context. Most of the participants were White, and thus the results may not be as applicable to students of other races and ethnicities [64] and the unique challenges they faced during ERT. Our sample size was too small to fully explore variation in experiences due to gender, race, socioeconomic status, etc. Nonetheless, the goal of this study was not to create a comparative study but to describe how the students experienced ERT. Additionally, the global pandemic necessitated conducting virtual interviews. While this made the interviews accessible both to the participants and the researcher, it was more difficult to develop the same level of rapport as an in-person interview. Finally, the results described in this paper are part of a summative evaluation and not a formative evaluation. Students' reactions to ERT were not captured in situ due to the lack of online observations. Therefore, instances where students were not responsive to in-class prompts, active participation in online synchronous discussions, or apprehensiveness created by being on camera constantly were not part of the data collection. These factors should be included in future studies that seek to evaluate students' response to ERT.

## 4. Results

The analysis of the student data revealed four themes in how students responded to ERT and how faculty can help students' ability to adapt. These four themes are: (1) challenges with remote learning, (2) compassionate flexibility of faculty, (3) student self-discipline, and (4) gendered response to ERT.

### 4.1. Challenges with Remote Learning

Students were given an open prompt to describe how ERT and the COVID-19 pandemic affected them. They did not have to tailor their responses specifically to class, but they offered their perspective of how ERT was handled in different classes, including "An Integrated Approach to Energy". Their responses reflected unique situations and challenges that affected their ability to learn in this remote setting. For example, some students described how COVID-19 had affected their immediate family members who were essential or front-line healthcare workers and how that translated to increased worry and stress. Not all students elected to share about their home and personal life but instead focused on the challenges specific to remote learning. These challenges were individually specific, and the results will focus on the three cross-cutting challenges: (a) increased workload, (b) inconducive learning environments, and (c) miscommunication.

The participants described their perception of increased workload in a variety of ways, but also struggled to pinpoint why they felt the workload had increased. When asked about how faculty have helped or hindered his ability to adapt to remote learning, Luigi stated that:

> "I've noticed, the homeworks, even for the energy class, have increased in length. And I don't know if that was originally planned and that was just going to happen anyway or if that's a result of the online stuff. But the kind of way that's kind of worked out isn't ideal. I noticed a very similar thing with all the other classes. Even when maybe a project at end of

> the school year is cut off, that percentage of our grade, instead of just them kind of taking that out, they're like, "Oh, well, we have to still add that in somewhere." And so that stress really doesn't go anywhere. They're still adding to the pile."

Some students perceived that they were getting more "busywork" and assignments to make up for the week they lost in the transition to ERT. They thought that faculty were continuing their classes as normal with a typical workload, without adjusting their schedules to reflect the current pandemic conditions. When asked about how faculty had helped or hindered her ability to adapt, Lexie stated that faculty hindered her when they "[ . . . ] gave us the same amount of expectations. Or tried to make up for the lost time that we had." Other students hinted that they thought faculty members perceived they had more free time because of the stay at home order, sometimes not even recognizing the pressure the students were under after some of them were asked to leave their dormitories and facing the uncertainty of housing issues. Some students described that they had an implicit expectation that the workload would be lessened because of the pandemic. While the participants struggled to find the root cause of why their workload had increased, Peter offered some insight into the issue—tasks took longer now than they did before. He stated:

> "I think in some of my other classes, both labs, they just take longer because you can't ask professors for help in class. Just figuring stuff out yourself. Like my Circuits lab takes almost twice as long now that we're just trying to grind it out and figure everything out for ourselves. And I'm sure we're learning better, but it's just like I have a lot less free time. Yeah. So, it does feel like stuff takes longer but I have a feeling they're the same assignments, we just don't have the same kind of help."

Another student described that they had to watch asynchronous class recordings multiple times to get the same amount of learning to pass their exams.

This perception that students could not get the same level of help they used to is also tied to another challenge of the **inconducive learning environment** that remote learning created. The students found it hard to focus during synchronous and especially asynchronous settings. They experienced frequent distractions by roommates or family, and some students described how they would fall asleep as they attended synchronous Zoom classes. What was most prevalent to the participants was how student–teacher and student–student interactions had changed as a result of ERT. The participants described the decrease in student participation. For example, Gloria remarked, "It is kind of weird that no one talks in class. I don't know. But I don't feel like . . . the environment isn't super like, 'Oh, let's just talk about these things.' And I don't know how we could change that, but that's just how it is." Rachel seconded this feeling and said, "It's harder to be more interactive and participate. Because it just all goes to silence sometimes and it's kind of hard to break."

Zoom was described as being both too informal (e.g., "feels like Facetiming [your professor]") and formal at the same time and "awkward". This awkwardness was most apparent when professors pointed out how students are not engaging in class. For example, Gloria said, "I feel bad when the teachers are like, 'Why isn't anyone talking?' But then it's like- I don't know—they're uncomfortable, and I'm uncomfortable [ . . . ] I don't really feel that welcome to talk even though I know I should." The students also described the hypervisibility they experience if they speak in some classes and how asking questions interrupts the flow of the lesson. Peter remarked on this by saying, "To ask a question, you have to unmute yourself and then the whole class stops and everyone's listening to your question." The participants contrasted this to their previous classroom experiences where they were constantly working in groups and could easily and unobtrusively raise their hand to ask the professor for help at any time. While students were aware that the faculty members were trying to increase class participation, the new setting was difficult for them to overcome.

The most difficult experience students described was that, because of this new learning environment, they felt they could not get help. This was especially prominent for classes where the students could not attend synchronously whether through their personal situations or because the

professor only posted asynchronous recordings. Lexie summarized this by saying, "I think recorded lectures have their benefits but also drawbacks because you can't ask questions if you're confused. It's very much just like reading a book, except someone's speaking it to you, so you can't really . . . I mean, you're on your own."

The other major challenge students described was **miscommunication** from faculty and from the university. The abrupt transition to remote learning caused widespread confusion for students, which was exacerbated by the conflicting communication from the university and their professors. They described the confusion they felt when they received abrupt communication that they had to evacuate their dorms and misleading, confusing, and contradicting information about P/F grading. For individual instructors, they experienced limited (and sometimes zero) communication about assignment deadlines and what to expect during the transition to remote learning. Some professors, Rebecca noted, "didn't even reach out to us or anything at all." The majority of these challenges students described in relation to other classes at their university. In contrast, they had highly positive experiences with the IntE faculty.

### *4.2. Compassionate Flexibility of Faculty*

While there was no shortage of challenges for students during ERT, the participants were more than willing to describe how faculty had helped them adapt and persevere. The students mainly focused on IntE professors and the actions they took. For the Spring 2020 semester, all the participants were students in "An Integrated Approach to Energy" taught by GDH and another engineering class taught by SML. The students noticed how IntE faculty attempted to make ERT effective, despite how little time they had to prepare. The faculty not only had to learn new technologies and tools, but also learn how to best teach using them. As Rachel shared:

> "Overall, I think, [SML] and [GDH], they've done a good job . . . the breakout rooms were really helpful because it was just more interactive and helped me be not as distracted. Whereas, in my other classes, it's just a bunch of students watching a video."

While the students admitted that remote learning was not the same as learning in person, they appreciated the effort and how adaptable the IntE faculty were. This type of pedagogy was fortified with faculty showing compassion and care for students by emotionally supporting them, being flexible in grading and assignments, providing accommodations (e.g., grading policy changes), and being accessible to students. The students described how they believed that IntE faculty authentically cared not only about their academic success but as individuals. Faculty could show this in many ways, one of which was actually asking their students how they were doing. In response to their perceived higher workload, Rachel noted, "[IntE faculty] send out surveys, they see how the online learning experience is going. Based on the surveys, they'll change their schedule or the workload they give each of us [ . . . ] my other teachers kind of don't do that." Rebecca echoed this by saying that IntE faculty assigned daily reflections to ensure they were not "pressuring us or overwhelming us with too much information or workload."

The students also appreciated accommodations made by the university or faculty. Accommodations, in this paper, include any official policy changes to classes or grading (e.g., changing assignment grading policies, P/F grading). The main accommodation students mentioned was the P/F grading option. For example, when prompted to "vent" about anything they wanted, Clara described the difficult situation her family was in because of the pandemic and added, "I appreciate that the school's allowing pass/fail options for classes. I'm taking two classes as pass/fail. . . . So that's been helpful, I think, in relieving stress." Other students mentioned P/F grading and how this option reduced their stress about classes they were uncertain about their grades in. Other ways to accommodate students were to provide more time to complete assignments or tests and grading based upon "effort" or "completion".

Some faculty showed flexibility by altering their class in response to the new learning format and in recognition of the hardship the global pandemic brought. The students described how some faculty adjusted their expectations or showed leniency. This flexibility even translated to being more accessible to students virtually. For example, when asked how faculty have helped him adapt to remote learning, Luigi responded:

> "I know a lot of professors have been more lenient with due dates and stuff, which has really been nice. And a lot of professors that I currently have are very flexible with office hours. If you want to talk about something, you can just email them and then just have a more of a private date if needed."

The faculty increasing accessibility to students (both in providing curriculum and giving students avenues to access their expertise) was valuable to students. However, accessibility was contingent on how the faculty communicated with students. Students were appreciative of faculty who responded to email promptly, who provided clear and transparent information about their class and what they needed to do to be successful, who personally connected them to resources or people to help them, and for reaching out to them. All the participants described moments where the IntE faculty reached out to them in one way or another. For example, Rebecca ended her interview with:

> "I really value how [GDH], [SML], and I'm sure a lot of the faculty, have been really responsive and really emphasizing on student feedback and asking how we're doing and seeing what they can do for us. And I think that's something that's really important right now with our difficult transition."

Feedback became a way for the IntE faculty to get a better idea of what worked, what needed improvement, but also how to help students create community. Sometimes these conversations extended to how to implement compassionate teaching in other classes outside of IntE.

### *4.3. Student Self-Discipline*

The faculty played a big role in helping students adapt, but the students also felt a responsibility for their own learning. The students had a variety of actions that best worked for them individually such as time management, being "present" in the ways that were possible with remote learning, removing distractions, and setting boundaries. All of these actions were rooted in the overarching strategy of being self-disciplined. Most students could identify time management as an integral part of self-discipline for remote learning. Students described creating and adhering to a schedule, finding ways to keep busy, getting work done right away, and batching time spent on schoolwork. One student, James, prided himself on his time management skills but indicated that remote learning required the additional development of those skills. He said:

> "So, I was already big on Google calendar. As soon as I get assigned a homework assignment, I put it as a mark in my Google calendar. And I've just been doing that way more forward than I usually like to. [ . . . ] I've been just taking the opportunity to try and learn better time management skills, especially with working in sequence with doing college. It's been a big experiment in how far I can push my time management skills."

Time management often went hand-in-hand with setting additional boundaries between school-time and free-time. This was achieved through various ways including attending class synchronously and removing distractions. Students tried to be "present" as much as was possible during ERT without being physically present. The students remarked how it was easier to stay motivated and pay attention if they attended class synchronously with their web cameras on. Peter remarked on the web cameras in particular:

> "I mean, think the webcam being on definitely. It just kind of makes you feel a little more present because when my webcam's off, it's just way easier to just go on my phone, but when

> my webcam's on, it's awkward to be on your phone in front of the professor. [ . . . ] I've noticed that just when I have mine on, not only do I learn better, but it's just easier to stay focused and I guess also be respectful to the professor because you have no idea what's happening when I do this."

This opinion was not universal, however. While for some students the presence of the camera made them feel like they could pay more attention and be present, other students felt like it was too invasive and contributed to an inconducive learning environment.

Lastly, an unexpected way students found to adapt to ERT was by showing compassion for faculty. The students expressed how they knew that faculty were also facing difficulty in adjusting to COVID-19 and ERT. When asked how faculty have helped or hindered him in adapting to remote learning, Chandler responded:

> "I think they've been very helpful. I mean, we're all kind of in it together, so yeah, the faculty have been helpful. They're just really understanding and trying to help us get the best we can, the best education we can out of this situation, which it makes sense. I totally understand. Yeah, but they're helpful and understanding, and I realize that they're going through the same thing too."

As indicated by Chandler's reflection, adapting to ERT sometimes required mutual compassion. The students realized that faculty experienced some of the same frustrations and were willing to show compassion in response to how the faculty showed them care and compassion.

### *4.4. Gendered Response to ERT*

One theme that unexpectedly emerged from the data was a gendered response to ERT. The women in this study brought up compassionate and flexible pedagogy more often than men, while men focused on individual actions they could take and their personal responsibility. Women were more likely to mention and admit to utilizing P/F grading in their interviews of their own volition. Additionally, the women in this study described personal challenges they and their family were experiencing because of COVID-19 (e.g., anxiety over family members as frontline healthcare workers, family members potentially losing their jobs). Men described their experience of having more free time during the stay at home order while women found themselves increasingly responsible for domestic duties. When given the opportunity to vent about anything in relation to COVID-19 or remote learning, Lexie first focused on her increased workload but then described how personal issues such as living in a different state exacerbated her stress. She stated:

> "I just wish there was a little bit more lenience because if my mom does get sick, what am I going to do? I'm going to have to take care of her. My dad doesn't live with us, so I don't want him getting sick either if he comes over."

Clara also brought up her family and domestic responsibilities when allowed to freely vent about her experience of COVID-19 and remote learning. She said:

> "I'm at home. I'm safe. I'm healthy. And my family is healthy. And so, I think that that is the most important thing for sure. Being at home, a lot of people make it seem like you have more free time now that we're quarantined. That's not true. I don't. I think I even have less now. I'm cooking a lot for my family as my mom works [ . . . ] And so she's been working 24/7, on calls 24/7, working her butt off, working on the weekends. And it's been challenging. So, I've been there to support her the best I can."

As indicated by Clara, she felt responsible for providing emotional support for her mother who was also working extra hours. In contrast, Tito remarked "I do have a lot of time, but I don't want to spend all that time doing more work." Tito's experience was not unique. Several male students

indicated that they were finding ways to stave off boredom or that they were "[ . . . ] always at home, not really doing anything else." Although the data indicated the emergence of gendered responses to ERT, this theme will require additional research to explore further.

## 5. Discussion

### 5.1. Challenges with ERT

The students faced many challenges during ERT, but the three most described by participants were (a) increased workload, (b) inconducive learning environments, and (c) miscommunication. It is not a surprise that the participants found ERT to be inferior to the face-to-face instruction they were familiar with. USD prides itself on small class sizes and personalized attention from faculty. This means that pedagogical expectations may have been high for ERT. The faculty were only given a week to completely change their class and the way they teach. Remote and fully online learning can be effective if adequately planned for and if expectations of both students and teachers are appropriate and well-defined [65]. However, in this crisis that required a rapid response, the faculty could only react to the best of their ability and available resources. Both the faculty and students had to find ways to adapt to their altered reality while managing their own fear, uncertainty, and inequities that were exacerbated by the global pandemic. To borrow a metaphor, this is like building a plane while flying it, with the plane also being on fire in this case.

The participants showed how they reacted to and navigated through inconducive learning environments that made it difficult to stay motivated and to be fully engaged in the virtual classroom. Some found that they had to go through the motions and make extra effort to feel like they were attending class in person. This included intentionally not lying in bed while attending class, keeping their web cameras active, and deliberately speaking up in class despite the hypervisibility that entailed. The majority of participants had to use time management skills such as making and adhering to a schedule and getting work done right away. At the same time, they perceived an increase in their workload even from faculty members who were flexible and empathetic to students' plight. Some of this could be due to the faculty trying to compensate for the lost week of instruction or focusing on things that the students could do on their own, such as homework assignments. Our analysis indicates that tasks now take students longer than they used to. This is supported by time management being the most mentioned method that the participants brought up. Not only do students have to be self-disciplined with the amorphous boundaries between school and free time, but they may also be expending considerable mental bandwidth on dealing with the stress and anxiety that the global pandemic has brought. Completing assignments and learning objectively takes longer to do during ERT, as was described by the student who had to watch asynchronous lectures more than once to understand them.

Compounding this issue is that students do not have the same level of access to faculty and their peers as they did face-to-face. The informal pathways to accessing information such as approaching a professor before class, stopping by for office hours, or talking to other students in and outside of class were removed. While formal pathways to access help exist, students may feel hesitance in utilizing them. In response, faculty members can be more explicit and transparent in their communication with students and provide opportunities such as arriving early or staying late after scheduled class time or offering to meet with students outside of normal office hours.

### 5.2. The Importance of Effective Communication

The literature is clear that effective communication is critical for institutions of higher education during a crisis that disrupts academic continuity [12,13,16,18,21]. The university plays a large role in communicating important information to students, but it is often left to individual faculty or staff to answer questions and to clarify any confusion. Faculty members can provide a sense of security and reliable information that students trust [16]. With this particular case, there was considerable confusion

around P/F grading in how it would affect students' futures which was compounded by logistical failures in implementation. The participants described how the IntE faculty deliberately reached out to clarify information about P/F grading and set about removing any stigma associated with using it.

Students are not the only ones who are affected by ineffective communication. Faculty members also need official university communication to be translated, and often through the same informal peer communication pathways that were removed because of ERT. Informal communication is sometimes the most important and effective way in which junior, untenured faculty members gain institutional knowledge [66]. The IntE department established informal communication pathways between each other and their students. Moving to remote teaching created a distance with students, both physically and emotionally and presented new challenges to students on how to navigate professionalism in an online setting. The results indicate that the students were appreciative of the many ways that IntE faculty communicated with them before and during ERT, often because that communication went hand-in-hand with a message that the faculty cared about them as people. In this case, showing care began when faculty members surveyed student needs and provided them with avenues to speak about their difficulties. Care extended beyond that, by the faculty being flexible, adjusting expectations, making accommodations, and making information and themselves accessible to students.

There has been discussion within higher education since the Spring 2020 semester ended about losing rigor by adjusting student expectations during this challenging time [5,6,67]. This is especially salient within the discipline of engineering, which often defines itself through rigor [44]. Making courses rigorous (often operationalized as difficult) does not necessarily improve student learning and, especially during a global pandemic, may actually inhibit students' ability to develop as engineers or develop their own critical consciousness. Our results and other reports suggest that we need to shift the instructional focus from difficulty to compassion [36,39]. We do not need to "lower" expectations for students, but rather be clearer about our expectations. This requires constant communication through multiple means (e.g., LMS, email, synchronous instruction) and being more purposeful about sending reminders. In times of crisis, we put forward that communication is not just about effectively providing information in a timely manner, but also about conveying that we care about students.

### 5.3. Compassion and Care

Students in engineering can tell whether faculty members authentically show compassion and care through how faculty design and provide curriculum content and how they interact inside and outside of the classroom [68]. In the midst of a crisis such as a pandemic, extra attention needs to be paid to showing students empathy and care. This can be more difficult in times of physical separation, but can be mitigated through frequently assessing and responding to student concerns, offering students more autonomy in meeting the requirements of the course, reducing time pressures for assessment, and making course materials and the professor more accessible [21,36]. Despite their own feelings of anxiety and stress, during ERT the faculty deliberately sought to support students by responding to their needs and being flexible [5]. This is not a one-way street, however. The participants also displayed compassion for their professors, describing how they were all in this together. This compassion helped them adapt to the challenges of remote learning. The students also showed compassion for their professors during other times of crisis such as during the 2011 Great East Japan Earthquake [16]. Compassion, however, may require faculty members and students to be open and honest with each other through effective communication. If faculty members and students engage in two-way communication, show care, and are flexible in their curriculum, students are likely to respond with flexibility and understanding. It is important to remember that "when things go back to normal, people will not remember the educational content delivered, but they will remember how they felt, how we cared for them, and how we supported them" [39] (p. iii).

### 5.4. Student Motivation and Autonomy

The students in this study appreciated and thrived when faculty showed compassion and flexibility, but they also took responsibility for their learning and being self-disciplined. The students remained motivated to complete their semester despite their various challenges. This is reminiscent of the self-determination theory [69]. Simply stated, this theory posits that if students have their needs of autonomy (i.e., ability and willingness to make and carry out decisions), competence (i.e., understanding and being efficacious at performing tasks), and relatedness (i.e., positive, secure relationships) met, they will be highly motivated to perform well. In a study of engineering students, relatedness was found to be the most salient need for students in supporting their motivation and that relatedness provided space to build competence [70]. For the students in this case study, relatedness was already established during the in-person teaching at the beginning of the semester and continued into ERT. The participants exercised their autonomy through the strategy of self-discipline (e.g., time management, being "present"). Faculty members intentionally provided opportunities for autonomy through flexible due dates, choice of assignments, and different ways to participate in class (i.e., synchronous or asynchronous, Slack, email etc.) We have provided a few actions that both students and faculty members can take to adapt to the challenges of ERT in Table 2.

It is important to note that a missing piece from Table 2 is how to facilitate social connections between students during ERT. We reported on the most frequently mentioned strategies students utilized to adapt, and while some participants mentioned social activities such as engaging in online study groups, these students already had established friendships and this strategy was not prevalent across the entire participant population. This suggests that this may be a critical area that students need help with and that faculty members are unsure how to address. One way for faculty to motivate engineering students is by fostering relatedness through assigning team projects or homework assignments [70]. This is especially important for first-year students who may not have made connections with their peers and do not have a support system yet.

**Table 2.** Student adaptations and corresponding ways faculty can support students during Emergency Remote Teaching.

| Challenge | Student Adaptation | Student Adaptation Examples | Faculty Support | Faculty Support Examples |
| --- | --- | --- | --- | --- |
| Increased Workload | Self-Discipline: Time Management | Making and following a schedule, keeping busy, getting work done right away, time batching. | Showing Compassion and Empathy (e.g., Flexibility) | Begin ERT with lessons that help students develop time management (and digital literacy) skills, adjust expectations and provide leniency, remove time pressures from assessment, make accommodations (e.g., P/F grading), increase the accessibility of course content (e.g., synchronous and asynchronous). |
| Inconducive Learning Environment | Self-Discipline: Being "Present" and Setting Boundaries | Going through the motions of face-to-face instruction, getting out of bed, attending class synchronously, turning on webcam, choosing to interact in class, working in peer groups, removing distractions, putting phone in another room while attending virtual class, setting clear boundaries. | Adjusting Pedagogy | Increase online teaching proficiency, increase teacher and student social presence in the virtual classroom, be adaptable by using virtual tools to interact in real time with students (e.g., Slack, Google Docs), use available active learning methods (e.g., polls, breakout rooms, requiring student interaction). |
| Miscommunication | Having Compassion for Others | Understanding that others were affected by the crisis, being more forgiving or lenient, knowing that everyone is in this together. | Clear and Frequent Communication | Survey students about resource needs, provide avenues for students to bring up issues, reach out to students, provide timely and transparent information, connect students to resources, be more accessible to students (e.g., Slack, Zoom office hours). |

## 6. Conclusions and Implications

At the beginning of the pandemic, people called COVID-19 the great equalizer because everyone, both rich and poor, young and old, could be affected by it. In truth, we quickly learned that the pandemic simply exacerbated existing inequities within society and within higher education. The university and IntE department pride themselves on being social justice-oriented, and with that comes pedagogies of compassion and care. COVID-19 and the transition to ERT showed us that we all have assumptions about the resources and skills that our students bring to class. When students were with us face-to-face, we did not have to consider that some students may not have technical resources such as personal laptops because they had access to computer labs on campus. We did not have to wonder if they had enough wi-fi bandwidth or cell phone data to meaningfully engage in class. We did not have to consider what time zone students were accessing synchronous instruction from. ERT created a physical divide between faculty and students, but it also required the faculty to pay more attention to their students' personal lives. This is something that, for many faculty members, is profoundly uncomfortable, but is key to setting students up for success in times of crisis. As educators oriented towards social justice, we aspire to be more aware of what assumptions we are unintentionally making about our students and act to make the classroom more equitable and accessible to all students. As engineering education continues to improve, so must the practices we integrate into our programs and, in particular, into our classrooms. Care and compassion in engineering education should not only be applicable to situations of extreme urgency, but they should become the new norm if we strive to make engineering a more inclusive space.

**Author Contributions:** Conceptualization, L.A.G., S.M.L, G.D.H., D.A.C., J.A.M.; Methodology, L.A.G.; Validation, L.A.G., S.M.L., G.D.H., D.A.C., J.A.M. Formal Analysis, L.A.G.; Writing—Original Draft Preparation, L.A.G., S.M.L., G.D.H., D.A.C.; Writing—Review and Editing, L.A.G., S.M.L., G.D.H., D.A.C., J.A.M.; Visualization, G.D.H.; Funding Acquisition, S.M.L., G.D.H., D.A.C., J.A.M. All authors have read and agreed to the published version of the manuscript.

**Funding:** This material is based upon work supported in part by the National Science Foundation (NSF) grants 1836504 and 1519453. Any opinions, findings, conclusions, or recommendations expressed in this material do not necessarily reflect those of NSF.

**Acknowledgments:** The authors would like to thank the students in the "Integrated Approach to Energy" class, particularly those who participated in interviews. We also thank the undergraduate researchers who assisted in reviewing this paper.

**Conflicts of Interest:** The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analysis, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

## References

1. Thomason, A. University of Washington Cancels In-Person Classes, Becoming First Major U.S. Institution to Do So Amid Coronavirus Fears. Available online: https://www.chronicle.com/article/U-of-Washington-Cancels/248198 (accessed on 14 September 2020).
2. Adhanom Ghebreyesus, T. WHO Director-General's Opening Remarks at the Media Briefing on COVID-19-11 March 2020. Available online: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020 (accessed on 31 August 2020).
3. Boettcher, J.V.; Conrad, R.M. *The Online Teaching Survival Guide: Simple and Practical Pedagogical Tips*, 1st ed.; Jossey-Bass: San Francisco, CA, USA, 2010; ISBN 978-0470423530.
4. Hodges, C.; Moore, S.; Lockee, B.; Trust, T.; Bond, A. The Difference between Emergency Remote Teaching and Online Learning. Available online: https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning (accessed on 22 October 2020).
5. Johnson, N.; Veletsianos, G.; Seaman, J. US Faculty and Administrators' Experiences and Approaches in the Early Weeks of the COVID-19 Pandemic. *Online Learn.* **2020**, *24*, 6–21. Available online: https://eric.ed.gov/?id=EJ1260365 (accessed on 26 July 2020). [CrossRef]

6. Neuwirth, L.S.; Jović, S.; Mukherji, B.R. Reimagining higher education during and post-COVID-19: Challenges and opportunities. *J. Adult Cont. Educ.* **2020**. [CrossRef]
7. Brown, S. COVID-19 Sent LGBTQ Students Back to Unsupportive Homes. That Raises the Risk They Won't Return. Available online: https://www.chronicle.com/article/Covid-19-Sent-LGBTQ-Students/248633 (accessed on 31 August 2020).
8. O'Keefe, L.; Rafferty, J.; Gunder, A.; Vignare, K. Delivering High-Quality Instruction Online in Response to COVID-19: Faculty Playbook. Available online: http://www.everylearnereverywhere.org/resources (accessed on 14 September 2020).
9. Lindsay, S.; Cagliostro, E.; Carafa, G. A systematic review of barriers and facilitators of disability disclosure and accommodations for youth in post-secondary education. *Int. J. Disab. Dev. Educ.* **2018**, *65*, 526–556. [CrossRef]
10. Cortellia, C.; Horowitz, S.H. The State of Learning Disabilities: Facts, Trends and Emerging Issues. Available online: https://www.ncld.org/wp-content/uploads/2014/11/2014-State-of-LD.pdf (accessed on 22 October 2020).
11. Crespo, I. Accessibility Dissonance: The Disability Community's Overlooked Fight for Remote Learning. Available online: https://www.statepress.com/article/2020/04/spmagazine-accessibility-dissonance-the-disability-communitys-overlooked-fight-for-remote-learning (accessed on 22 October 2020).
12. Schuh, J.H.; Santos Laanan, F. Forced transitions: The impact of natural disasters and other events on college students. *New Dir. Stud. Ser.* **2006**, *114*, 93–102. [CrossRef]
13. DiCarlo, R.P.; Hilton, C.W.; Chauvin, S.W.; Delcarpio, J.B.; Lopez, F.A.; McClugage, S.G.; Letourneau, J.G.; Smith, R.; Hollier, L.H. Survival and recovery: Maintaining the educational mission of the Louisiana State University School of Medicine in the aftermath of Hurricane Katrina. *Acad. Med.* **2007**, *82*, 745–756. [CrossRef] [PubMed]
14. Gardner, S.K.; Miller, K.; Barker, M.J.; Loftin, J.; Erwin, M.; Maurin, K. Student affairs and Hurricane Katrina: Contextual perspectives from five institutions of higher education in New Orleans. *NASPA J.* **2007**, *44*, 209–232. [CrossRef]
15. Lorenzo, G. The Sloan semester. *J. Asynchronous Learn. Netw.* **2008**, *12*, 5–40. [CrossRef]
16. Gómez, O.A. Lessons from international students' reaction to the 2011 Great East Japan Earthquake: The case of the School of Engineering at Tohoku University. *Int. J. Disast. Risk Sci.* **2013**, *4*, 137–149. [CrossRef]
17. Mackey, J.; Gilmore, F.; Dabner, N.; Breeze, D.; Buckley, P. Blended learning for academic resilience in times of disaster or crisis. *J. Online Learn. Teach.* **2012**, *8*, 122–135. Available online: https://jolt.merlot.org/vol8no2/mackey_0612.pdf (accessed on 26 July 2020).
18. Tull, S.; Dabner, N.; Ayebi-Arthur, K. Social media and e-learning in response to seismic events: Resilient practices. *J. Open Flex. Distance Learn.* **2017**, *21*, 63–76. Available online: https://www.learntechlib.org/p/180237/ (accessed on 22 July 2020).
19. Wright, S.; Wordsworth, R. Teaching through 10,000 Earthquakes: Constructive Practice for Instructors in a Post-Disaster Environment. *Int. J. Teach. Learn. High. Educ.* **2013**, *25*, 144–153. Available online: https://files.eric.ed.gov/fulltext/EJ1016431.pdf (accessed on 22 July 2020).
20. Czerniewicz, L.; Trotter, H.; Haupt, G. Online teaching in response to student protests and campus shutdowns: Academics' perspectives. *Int. J. Educ. Technol. High. Educ.* **2019**, *16*, 43. [CrossRef]
21. Swartz, B.C.; Gachago, D.; Belford, C. To care or not to care-reflections on the ethics of blended learning in times of disruption: The ethics of care & academic development. *S. Afr. J. High. Educ.* **2018**, *32*, 49–64. [CrossRef]
22. SchWeber, C. Determined to learn: Accessing education despite life-threatening disasters. *J. Asynchronous Learn. Netw.* **2008**, *12*, 37–43. Available online: http://sloanconsortium.org/jaln/v12n1/determined-learn-accessing-education-despite-life-threatening-disasters (accessed on 26 July 2020). [CrossRef]
23. Van, D.; McLaws, M.L.; Crimmins, J.; MacIntyre, C.R.; Seale, H. University life and pandemic influenza: Attitudes and intended behaviour of staff and students towards pandemic (H1N1) 2009. *BMC Public Health* **2010**, *10*, 130. [CrossRef] [PubMed]
24. Santibañez, S.; Fiore, A.E.; Merlin, T.L.; Redd, S. A primer on strategies for prevention and control of seasonal and pandemic influenza. *Am. J. Public Health* **2009**, *99*, S216–S224. [CrossRef] [PubMed]

25. Day, T. Academic continuity: Staying true to teaching values and objectives in the face of course interruptions. *Teach. Learn. Inq. ISSOTL J.* **2015**, *3*, 75–89. Available online: https://www.jstor.org/stable/10.2979/teachlearninqu.3.1.75 (accessed on 22 July 2020). [CrossRef]
26. Bryson Taylor, D. A Timeline of the Coronavirus Pandemic. Available online: https://www.nytimes.com/article/coronavirus-timeline.html (accessed on 24 July 2020).
27. Lipka, S. After Katrina, Colleges Nationwide Take a Fresh Look at Disaster Plans. Available online: https://www.chronicle.com/article/after-katrina-colleges-nationwide-take-a-fresh-look-at-disaster-plans (accessed on 28 July 2020).
28. Schroeder, R. What Katrina Taught Us about Online Delivery. Available online: https://www.insidehighered.com/digital-learning/blogs/online-trending-now/what-katrina-taught-us-about-online-delivery (accessed on 28 July 2020).
29. Young, J. Staying the Course. Available online: https://www.chronicle.com/article/staying-the-course-7980/ (accessed on 21 October 2020).
30. Black College Wire. Displaced Katrina College Students Finish Classes Online. *Diverse Issues in Higher Education.* Available online: https://diverseeducation.com/article/5762/ (accessed on 28 July 2020).
31. Anderson, B.; Simpson, M. Ethical issues in online education. *Open Learn. J. Open Dist. E-Learn.* **2007**, *22*, 129–138. [CrossRef]
32. Anderson, B. New Zealand: Is online education a highway to the future? In *Global Perspectives on E-Learning: Rhetoric and Reality*; Carr-Chelman, A.A., Ed.; Sage: Thousand Oaks, CA, USA, 2005; pp. 163–178, ISBN 978-1412904889.
33. Levenson, R.W.; Ruef, A.M. Empathy: A physiological substrate. *J. Personal. Soc. Psychol.* **1992**, *63*, 234–246. [CrossRef]
34. Goleman, D. *Emotional Intelligence*; Bantam: New York, NY, USA, 2006; ISBN 9780553903201.
35. Noddings, N. The caring relation in teaching. *Oxf. Rev. Educ.* **2012**, *38*, 771–781. [CrossRef]
36. Means, B.; Neisler, J.; Langer Research Associates. Suddenly Online: A National Survey of Undergraduates during the COVID-19 Pandemic. Available online: https://digitalpromise.org/wp-content/uploads/2020/07/ELE_CoBrand_DP_FINAL_3.pdf (accessed on 14 September 2020).
37. Engineering Education Transformations Institute [EETI]. Responding to the COVID-19 Crisis: Making a Change through Your Stories Interim Brief 1: 10 April–19 April 2020. Available online: https://eeti.uga.edu/wp-content/uploads/2020/04/RAPID-Report-1-April-10-19-Final.pdf (accessed on 31 August 2020).
38. Engineering Education Transformations Institute [EETI]. Responding to the COVID-19 Crisis: Making a Change through Your Stories Interim Brief 2: 20 April–13 May 2020. Available online: https://eeti.uga.edu/wp-content/uploads/2020/05/RAPID-Report-2-April-20-May-13.pdf (accessed on 31 August 2020).
39. Bozkurt, A.; Sharma, R.C. Emergency remote teaching in a time of global crisis due to Coronavirus pandemic. *Asian J. Dist. Educ.* **2020**, *15*, i–vi. Available online: https://asianjde.org/ojs/index.php/AsianJDE/article/view/447 (accessed on 10 August 2020).
40. Alvarez, A.J. The phenomenon of learning at a distance through emergency remote teaching amidst the pandemic crisis. *Asian J. Dist. Educ.* **2020**, *15*, 127–143. Available online: http://asianjde.org/ojs/index.php/AsianJDE/article/view/453 (accessed on 10 August 2020).
41. Creswell, J.W. *Qualitative Inquiry & Research Design: Choosing among Five Approaches*, 3rd ed.; Sage: Los Angeles, CA, USA, 2013; ISBN 978-14-129-9530-6.
42. Case, J.M.; Light, G. Emerging research methodologies in engineering education research. *J. Eng. Educ.* **2011**, *100*, 186–210. [CrossRef]
43. Cech, E.A. The (mis) framing of social justice: Why ideologies of depoliticization and meritocracy hinder engineers' ability to think about social injustices. In *Engineering Education for Social Justice*; Lucena, J., Ed.; Springer: Dordrecht, The Netherlands, 2013; pp. 67–84. ISBN 978-94-007-6349-4.
44. Riley, D. Rigor/Us: Building boundaries and disciplining diversity with standards of merit. *Eng. Stud.* **2017**, *9*, 249–265. [CrossRef]
45. Lord, S.M.; Mejia, J.; Hoople, G.D.; Przestrzelski, B.; Chen, D.A.; Dalrymple, O.; Reddy, E.; Choi-Fitzpatrick, A. Creative Curricula for Changemaking Engineers. In Proceedings of the World Engineering Education Forum (WEEF 2018), Albuquerque, NM, USA, 12–16 November 2018. [CrossRef]
46. Hoople, G.D.; Choi-Fitzpatrick, A. *Drones for Good: How to Bring Sociotechnical Thinking into the Classroom*; Morgan & Claypool: Williston, VT, USA, 2020. [CrossRef]

47. Momo, B.; Hoople, G.D.; Chen, D.A.; Mejia, J.A.; Lord, S.M. Broadening the Engineering Canon: How Culturally Responsive Pedagogies Can Help Educate the Engineers of the Future. *Murmurations* **2020**, in press. [CrossRef]
48. Chen, D.A.; Peters, M.; Hoople, G.D.; Mejia, J.; Lord, S.M. Vocation in the Engineering Curriculum: Challenging Students to Recognize Their Values. In Proceedings of the ASEE Annual Conference & Exposition (2019 ASEE), Tampa, FL, USA, 15–19 June 2019; Available online: https://peer.asee.org/33543 (accessed on 27 October 2020).
49. Lord, S.M.; Olson, R.; Roberts, C.A.; Baillie, C.; Dalrymple, O.O.; Perry, L.A. Developing Changemaking Engineers—Year Five. In Proceedings of the 2020 ASEE Virtual Annual Conference, (2020 ASEE), 22–26 June 2020; Available online: https://peer.asee.org/34427 (accessed on 15 September 2020).
50. Gelles, L.A.; Lord, S.M. The Final Straw: Incorporating Accessibility and Sustainability Considerations into Material Selection Decisions. In Proceedings of the 2020 ASEE Virtual Annual Conference, (2020 ASEE), 22–26 June 2020; Available online: https://peer.asee.org/35319 (accessed on 15 September 2020).
51. Gelles, L.A.; Lord, S.M. Investigating using a "social impact audit" tool to support students' decision-making in a materials science course. In Proceedings of the Frontiers in Education Conference (2020 FIE), Uppsala, Sweden, 21–24 October 2020; Available online: https://aic-atlas.s3.eu-north-1.amazonaws.com/projects/e7299991-eb2b-4764-a849-4909e01fb07d/documents/L7Z8ngw1XaORBl3JtPNASLjIqjZ5U9IHE6FJflLK.pdf (accessed on 15 September 2020).
52. Hoople, G.D.; Chen, D.A.; Gelles, L.A.; Mejia, J.A.; Lord, S.M. An Integrated Approach to Energy Education in Engineering. *Sustainability* **2020**, unpublished, manuscript accepted with minor revisions.
53. McGinn, M.K. Researcher-participant relationships. In *The SAGE Encyclopedia of Qualitative Research Methods*; Given, L.M., Ed.; Sage: Thousand Oaks, CA, USA, 2008; pp. 768–771. ISBN 978-141294163.
54. Glesne, C. *Becoming Qualitative Researchers: An Introduction*, 3rd ed.; Pearson Education, Inc.: Boston, MA, USA, 2006; ISBN 978-0205458387.
55. Haynes, K. A therapeutic journey? Reflections on the effects of research on researcher and participants. *Qual. Res. Org. Manag.* **2006**, *1*, 204–221. [CrossRef]
56. Rossetto, K.R. Qualitative research interviews: Assessing the therapeutic value and challenges. *J. Soc. Pers. Relat.* **2014**, *31*, 482–489. [CrossRef]
57. Thomas, D.R.; Hodges, I.D. *Designing and Managing Your Research Project: Core Knowledge for Social and Health Researchers*; Sage: London, UK, 2010. [CrossRef]
58. Scott, C.R. Anonymity in applied communication research: Tensions between IRBs, researchers, and human subjects. *J. App. Comm. Res.* **2005**, *33*, 242–257. [CrossRef]
59. Saldaña, J. *The Coding Manual for Qualitative Researchers*, 3rd ed.; Sage: Los Angeles, CA, USA, 2016; ISBN 978-1-4739-0248-0.
60. Vogt, W.P.; Vogt, E.R.; Gardner, D.C.; Haeffeke, L.M. *Selecting the Right Analyses for Your Data: Quantitative, Qualitative, and Mixed Methods*; Guilford: New York, NY, USA, 2014; ISBN 978-1-4625-1576-9.
61. Butler-Kisber, L.; Poldma, T. The power of visual approaches in qualitative inquiry: The use of collage making and concept mapping in experiential research. *J. Res. Pract.* **2010**, *6*, M18. Available online: http://jrp.icaap.org/index.php/jrp/article/view/197/196 (accessed on 24 August 2020).
62. Maxwell, J.A. *Qualitative Research Design: An Interactive Approach*, 3rd ed.; Sage: Thousand Oaks, CA, USA, 2013; ISBN 978-1-4129-8119-4.
63. Charmaz, K. *Constructing Grounded Theory*, 2nd ed.; Sage: Thousand Oaks, CA, USA, 2014; ISBN 978-08-570-2914-0.
64. Pawley, A.L. Shifting the "default": The case for making diversity the expected condition for engineering education and making whiteness and maleness visible. *J. Eng. Educ.* **2017**, *106*, 531–533. [CrossRef]
65. Li, C.S.; Irby, B. An overview of online education: Attractiveness, benefits, challenges, concerns and recommendations. *Coll. Stud. J.* **2008**, *42*, 302–307. Available online: https://www.learntechlib.org/p/103183/?nl=1 (accessed on 28 August 2020).
66. Saldana, L.P.; Castro-Villarreal, F.; Sosa, E. "Testimonios" of Latina Junior Faculty: Bridging Academia, Family, and Community Lives in the Academy. *Educ. Found.* **2013**, *27*, 31–48. Available online: https://files.eric.ed.gov/fulltext/EJ1013834.pdf (accessed on 20 September 2020).
67. Davidson, C. Quantity Is Not Rigor. Available online: https://www.insidehighered.com/advice/2020/05/13/academics-should-rethink-way-they-assign-homework-opinion (accessed on 20 September 2020).

68. Youmans, K. "You Can Tell They Care": A Phenomenographic Study of Student Experiences with Empathic Concern Expressed by Professors in Engineering. Ph.D. Thesis, Utah State University, Logan, UT, USA, 2020.
69. Ryan, R.M.; Deci, E.L. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am. Psychol.* **2000**, *55*, 68–78. [CrossRef] [PubMed]
70. Trenshaw, K.F.; Revelo, R.A.; Earl, K.A.; Herman, G.L. Using self-determination theory principles to promote engineering students' intrinsic motivation to learn. *Int. J. Eng. Educ.* **2016**, *32*, 1194–1207. Available online: http://selfdeterminationtheory.org/wp-content/uploads/2017/05/2016_Trenshaw_etal_IJEE.pdf (accessed on 23 October 2020).