

Engineering Instructors' Self-Reported Emotions During Emergency Remote Teaching

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Abstract—This Research paper explores engineering instructors' ability to emotionally adapt to remote teaching and whether they felt their emotions were typical compared to a non-COVID semester. Participants, including engineering professors of practice, tenure-track and tenured faculty from five engineering disciplines completed weekly online surveys during the last seven weeks of the Spring 2020 semester. Adaptability, as a framework, was used to examine instructors' emotions over the initial weeks of remote instruction. Descriptive statistics were used to explore engineering instructors' emotions across the seven weeks and typicality of these emotions as compared to a non-COVID semester. The findings revealed that over the seven-week period, instructors reported their emotions as being more positive than negative. More than half of the instructors felt their emotions were atypical during the first four weeks and typical during the last three weeks. In addition, many instructors (73%) felt accomplished by the end of the semester. Understanding instructors' feelings during this forced change to emergency remote teaching can serve to identify emotional support needed for faculty to be able to change.

Keywords—COVID-19, emotions, emergency remote teaching, adaptability, instructors, engineering.

I. INTRODUCTION

The massive disruption caused by the COVID-19 pandemic has been felt in practically all aspects of everyday life, but its effects were particularly strong in education. This pandemic altered the landscape of teaching and learning in higher education, forcing higher education institutions to change the way they predominately delivered instruction for years [1]. To mitigate the spread of the COVID-19 virus and ensure the safety of students, instructors, and staff, universities in Spring of 2020 entirely closed campuses, transitioning all face-to-face courses to remote instruction within a couple of weeks. Engineering instructors were required to change their instructional practices and modalities to support remote learning, which required unprecedented adoption of assessment tools and teaching strategies not typical of engineering. This forced transition added a level of disruption and emotional stress for instructors they had not experienced before [2-3], requiring them to quickly adapt to meet the demands of the evolving situation. In these challenging times, the impact the transition had on engineering instructors' emotions provides insight into instructors'

adaptability during this forced change to emergency remote teaching.

II. BACKGROUND

A. Emergency Remote Teaching in Engineering

In light of the COVID-19 pandemic, emergency remote teaching (ERT) emerged as a new concept in higher education [2, 3]. Emergency remote teaching is defined as "a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances" [2, p. 7]. Emergency remote teaching is not synonymous with traditional pathways to adopting online learning, which is a long-term development process to ensure optimal learning in a fully digital format [2, 4]. ERT, in contrast, is unplanned and enacted in response to a catastrophe to provide temporary remote access to instruction that would normally be delivered physically or in a hybrid/blended format [2, 3]. The shift to ERT occurs quickly, providing instructors insufficient time to carefully design instructional materials and understand effective instructional practices/modalities to facilitate remote teaching [2]. This abrupt transition to ERT can be onerous for novice instructors who lack prior experience teaching online or have not previously incorporated the institution's learning management system (LMS) into their instruction [2-4]. Most importantly, the quick pivot to ERT can be emotionally taxing for novice online instructors who are not accustomed to online teaching [3]. Similarly, this impact of the transition can be significantly challenging for programs (e.g., engineering) that are traditionally taught face-to-face [3]. Due to unprecedented events associated with COVID-19, research has begun to study the effect of ERT on instructors and students across higher education, including engineering education [3, 5-6].

In engineering, studies have investigated the impact of ERT on students' and instructors' experiences and engagement in higher education [3, 5-6]. For instance, Gelles *et al.* [3], explored engineering students' response to ERT and ways that instructors supported students during the transition. The authors found that the hasty transition to ERT caused students to confront many challenges (e.g., increased workloads, miscommunication, and inconducive learning environments). During the initial transition to ERT, instructors were encouraged to support students through a compassionate and flexible pedagogy [3]. In a concurrent study, Panther and Diefes-Dux [5], examined instructors' self-reported engagement in teaching related activities and self-

assessment of the normality of these activities. The finding of this study revealed that instructors engaged in both self-directed and community-based activities to facilitate remote teaching, many of which they identified as being atypical compared to a non-COVID semester. Whereas a report presented by University of Georgia's Transformative Initiative [6] found that, while both students and faculty reported difficulties working from home, faculty members were adapting well to the crisis by exercising agency during ERT. These studies highlight the need to further explore faculty emotions during these difficult times.

ERT is an emerging and evolving problem, one that is distinct from traditional online learning [2]. Consequently, research is still lacking on all aspects of emergency remote teaching related to COVID-19, particularly in engineering education. Furthermore, the widespread shift to fully remote teaching and learning in engineering education as result of COVID-19 was a new phenomenon [7]. In such circumstances, it is pertinent to examine engineering instructors' ability to emotionally adapt to ERT and the normality of these emotions. The lessons learned from instructors' feelings during this forced change to ERT can be translated into future change efforts to enable instructors' adaptability and change in engineering.

III. THEORETICAL FRAMEWORK: ADAPTABILITY

Adaptability is defined as an individual's ability to "constructively regulate psycho behavioral functions in response to new, changing, and/or uncertain circumstances, conditions and situations" [8, p. 66]. Adaptability is a key mental resource that entails individual's cognitive, behavioral, and emotional regulation in situations of change, novelty, and uncertainty [8]. An individual's resources are crucial to dealing with stressful situations [8]. In essence, individuals with high cognitive ability have a greater capacity to assess challenging situations and deal with such challenges emotionally [9-10]. Moreover, researchers have found that emotional stability is a predictor of adaptability since it "directly deals with handling stress and adapting to changing situations" [9, p. 303]. As Martin *et al.* [11] suggests, an individual's ability to adapt in response to changing circumstances can promote positive psychological well-being. Therefore, individuals with a high level of adaptability can "reserve more psychological resources than individuals with a low level of adaptability" [12, pp. 1]. Adaptability, as a framework, has been used broadly to explore change at the individual and organizational levels [11-13]. Moreover, the theory of adaptability has been used to understand change pertaining to academic well-being [8, 11-14]. Hence, for this study, adaptability, as the theoretical framework, is a useful lens for considering changes in instructors' emotions over the initial weeks of remote instruction since emotional regulation is one of the constructs of adaptability.

IV. RESEARCH PURPOSE AND QUESTION

The purpose of this study was to examine the emotions that engineering instructors experienced during the initial weeks of the transition to remote teaching in Spring 2020 and their self-assessment of the typicality of these emotions as compared to non-COVID times. This work is part of a larger research project looking at instructors' learning, community interactions, and successes and challenges during the early weeks of this transition [5, 14, 20] and in the year following. The research

question addressed in this study is: *How do instructors' emotions change over time when forced to transition to remote instruction?*

V. METHODS

A. Participants and Settings

All engineering instructors teaching undergraduate courses in the seven departments of the College of Engineering at an R1 Midwest university in United States were invited to participate in the Spring 2020 study. Of the 161 engineering instructors invited to participate, 57 instructors volunteered. In this study, we only include data from instructors who were tenured or tenure-track professors and professors of practice ($n = 39$) (Table I).

TABLE I. ENGINEERING INSTRUCTOR PARTICIPANTS DEMOGRAPHIC CHARACTERISTICS

Category	Subgroup	n	%
Gender	Male	28	72%
	Female	11	28%
Position	Assistant Tenure-Track Professor	12	31%
	Associate and Full Professor	15	38%
	Assistant Tenure-Track Professor of Practice	9	23%
	Associate and Full Professor of Practice	3	8%
Department	Architectural and Construction Engineering	5	13%
	Biological Systems Engineering	7	18%
	Civil and Environmental Engineering	9	23%
	Computer Science and Engineering	7	18%
	Mechanical and Materials Engineering	7	18%
	Other*	4	10%

*Chemical & Biomolecular Engineering and Electrical & Computer Engineering departments were combined to ensure confidentiality due to low participation rates.

B. Survey Instruments

The study instrument was an online survey that collected information about participants activities and emotions during each of the last seven weeks of the Spring 2020 semester. The survey items were of three forms: multiple select, multiple choice, and open-ended [5, 14]. A timeline of events, beginning with the closing of the university in week 9 of the semester through to the issuing of final semester grades, is provided in Fig 1. Survey administration occurred each week starting in week 12. The surveys were emailed on Fridays, and instructors had until the following Tuesday to complete a given week's survey. The weekly response rate across the seven surveys varied from 77% to 92%. The Cronbach's alpha coefficient was calculated for survey reliability, which yielded an alpha coefficient of 0.83, indicating a high level of internal consistency [5].

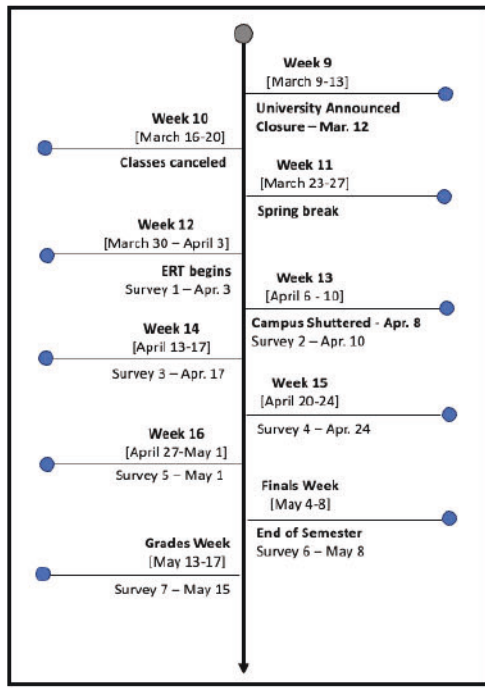


Fig 1. Timeline of university's transition to ERT and survey administration.

This study is an analysis of participants' responses to a multiple-select and multiple-choice pair of items over the seven-week period. For the multiple select item, instructors were asked to identify (out of 48 words, Table II) "which words best describe how you felt about teaching this past week?" The list of emotions were randomly displayed to each participant. To develop this item, the researchers began with words from Drummond's Vocabulary and Emotions /Feelings [15] which were given in 10 categories with strong, medium, and light subcategories. As Drummond's list focused primarily on negative emotions, the researchers developed five new categories that were antonyms of existing categories and split one category that seemed to indicate two different emotions for the context of this study (Table II). From each of the original categories, one word from each subcategory that best matched the instructional context of this study was selected for inclusion in the survey. For the new categories, antonyms were identified. The words included in the survey administered to participant included 16 categories of words (eight positive and eight negative). According to the literature emotions are best measured with words that can have the highest possibility of being used to describe an individual's feelings [15-17]. Thus, the words within the sorted categories and the positive and negative categories of emotions themselves were phrased to match the terms generally used by individuals [15-17].

The multiple-choice item used a four-point scale (1= "strong agree" to 4 = "strongly disagree") and asked, "In general, the feelings I indicated above are similar to those I have felt in a typical week prior to the COVID-19 mandate for remote instruction." During data analysis, the agreement options, "strongly agree" and "agree," were merged to represent "Typical" emotions. While the disagreement options, "strongly disagree" and "disagree," were merged to represent "Atypical" emotions.

TABLE II. EMOTIONS LISTED IN THE SURVEY

Positive Emotions			
Happiness	Excited	Happy	Pleased
Adequate^a	Empowered	Competent	Certain
Committed^b	Devoted	Trusting	Interested
Caring	Compassionate	Sympathetic	Thoughtful
Positivity^a	Optimistic	Hopeful	Encouraged
Stable^a	Composed	Content	Calm
Braced^a	Supported	Included	Connected
Accomplished^a	Triumphant	Satisfied	Relieved
Negative Emotions			
Depression	Defeated	Distressed	Disappointed
Inadequate	Powerless	Overwhelmed	Unsure
Fear	Intimidated	Nervous	Cautious
Confusion	Flustered	Frustrated	Uncomfortable
Hurt	Devastated	Devalued	Minimized
Anger	Outraged	Irritated	Resentful
Loneliness	Isolated	Alienated	Detached
Remorse	Exposed	Guilty	Embarrassed

^aCategories added to [15]

^bCaring was split to focus on Committed (caring about oneself) and Caring (about others).

C. Data Analysis

Descriptive statistics were used to explore engineering instructors' emotions from week 12 (of 16) through the issuing of final grades in Spring 2020. Similar to Panther and Diefes-Dux [5], three analyses were conducted to explore instructors' emotions.

In the first analysis, the number of weeks in which instructors selected at least one emotion in a given category were counted. For example, if participant A selected Excited and Happy in week 12 and Pleased in week 14, participant A was counted as having selected Happiness in two weeks out of seven. The frequency counts were then used to calculate a percentage distribution by number of weeks for each emotion category using all 39 participants as the basis [18].

In the next analysis, frequency counts of instructors that selected at least one positive emotion and/or one negative emotion were determined. Then, the frequencies were used to compute percentages out of those that participated in a given week's survey ($n=30-36$). These results were considered with reference to the percent of instructors who indicated that the emotions they felt were typical.

Finally, trends in each of the 16 categories of emotions during the seven weeks were explored. Frequency counts of instructors who selected at least one word within a given emotion were determined. The frequency counts were then converted to percentages based on the number of survey participants in a given week ($n=30-36$).

VI. RESULTS

A. Instructors' Feelings about Teaching

Fig. 2 and 3, illustrates the number of weeks (out of seven) each instructor reported at least one emotion in a given category. In Fig. 2, the positive emotions instructors selected across all weeks are presented. While in Fig. 3, the negative emotions instructors selected across all weeks are presented.

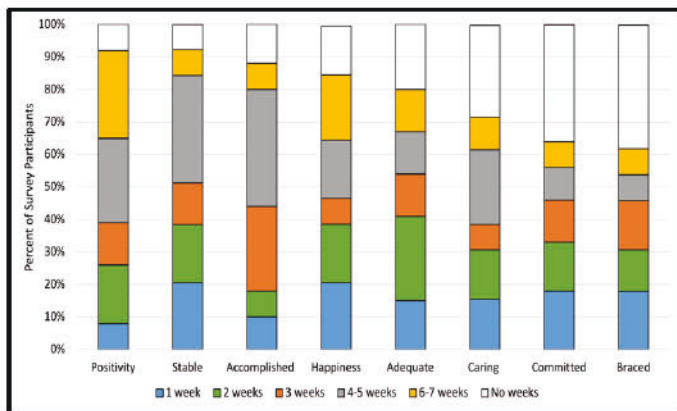


Fig. 2. The number of weeks participants selected at least one positive emotion from a given category during the seven-week period ($n=39$)

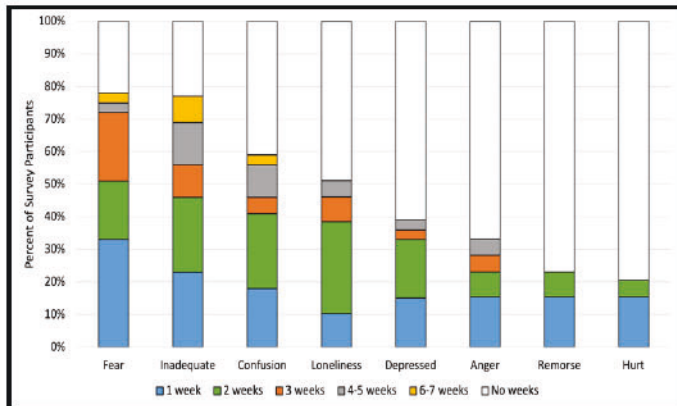


Fig. 3. The number of weeks participants selected at least one negative emotion from a given category during the seven-week period ($n=39$)

Overall instructors selected more positive emotions than negative emotions. Within the positive emotions, instructors most frequently reported feelings within the Positivity category, with 84% of participants reporting this emotion in two or more weeks. Similarly, 72% and 78% of participants reports feeling an emotion in the Stable and Accomplished categories, respectively, in two or more weeks. Participants reported feelings within the Committed and Braced categories in fewer weeks than other positive emotions.

Within negative emotions, instructors reported feeling an emotion in the Fearful (78%) and/or Inadequate (77%) categories in one or more weeks over the seven-week period. No instructor reported feeling an emotion in the Loneliness, Depressed, Anger, Remorse and Hurt categories in six and more weeks. Emotions within the Remorse and Hurt categories were the least cited emotions by instructors, with no instructor reporting these emotions in these categories in three or more weeks.

B. Typicality of Positive and Negative Emotions

Fig. 4 shows instructors' weekly positive and negative emotions over the seven-week period. An instructor was considered to have expressed a positive emotion in a given week if they had selected at least one emotion listed within the eight positive categories. A similar approach was taken for negative

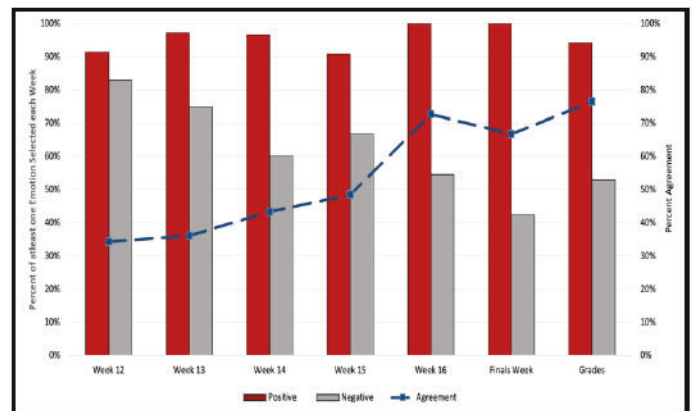


Fig. 4. Positive and negative emotions each week and overall agreement of typicality in the two categories of emotions ($n = 30-36$ depending on survey participation)

emotions. As was demonstrated in Fig. 2-3 and echoed in Fig. 4, positive feelings were selected more frequently than negative feelings, and the percent of instructors indicating at least one positive emotion stayed above 90% across the seven weeks.

In week 12, 83% of the instructors self-reported at least one negative emotion about teaching. The number of instructors reporting negative emotions declined through Finals Week with the exception of week 15. Fig. 4 also illustrates the percent of instructors who felt these emotions were typical of a non-COVID semester. The instructors' agreement that these emotions were typical (blue line) applied to all emotions they selected in a given week. More than 50% of instructors felt their emotions about teaching were atypical in weeks 12 through 15. Many instructors agreed that their emotions were typical from week 16 through to the issuing of grades.

C. Trends in Individual Emotion

Fig. 5 and 6 show instructors' weekly emotions about teaching in each of the eight positive and eight negative emotions categories, respectively. Figure 5 shows that instructors, in general, frequently cited at least one emotion in the Positivity category in weeks 12 to 15 and in the Accomplished category from week 16 and onward. In each week, more instructors reported a feeling in the Caring category than in the Committed category. By week 15, instructors selected feelings in the Braced category infrequently compared to other emotions, with a low of 18% of instructors selected a Braced emotion by end of the seven-week period.

Fig. 6 shows that instructors selected at least one feeling in the Inadequate category more frequently than any other negative category each week, with the exception of week 16, where Fear tied. In general, emotions within the categories of Inadequate, Fear, Confusion, and Loneliness were most frequently selected by instructors across the survey period. In comparison, emotions within the categories of Depression, Anger, Remorse, and Hurt were less frequently selected across the survey weeks. But again, looking across Figures 5 and 6, it can be seen that instructors selected negative emotions far less frequently than positive emotions.

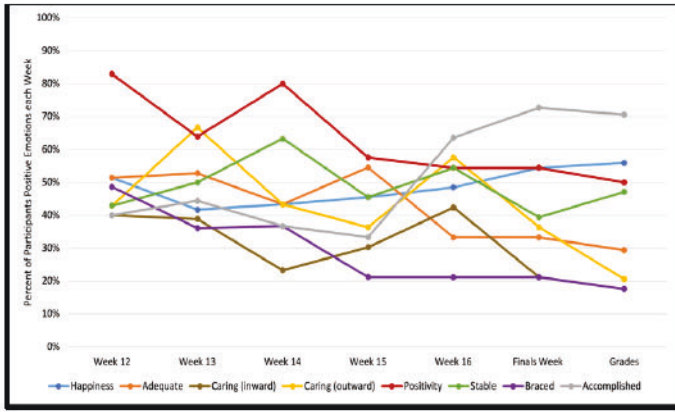


Fig. 5. Participants selecting at least one of the emotions about teaching in a given positive category each week (n = 30-36 depending on survey participation).

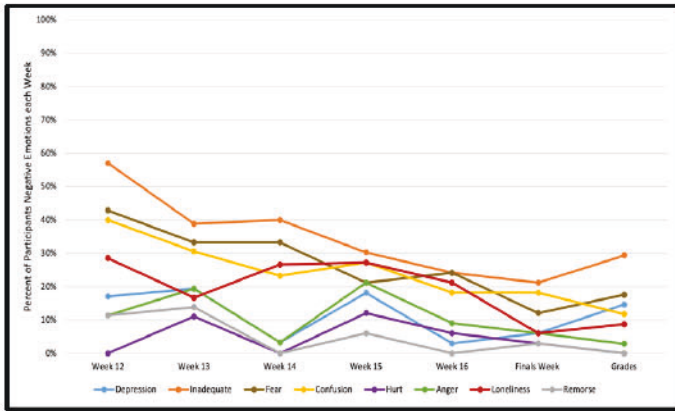


Fig. 6. Participants weekly negative emotions about teaching (n = 30-36 depending on survey participation)

VII. DISCUSSION

The results of this study contribute new knowledge on instructors' ability to adapt by identifying instructors' emotions during the early days of the crisis that resulted in ERT. A number of findings are clear. First, across the seven-weeks instructors reported more positive emotions, with a majority feeling positivity and stable about remote teaching in two or more weeks following the transition, suggesting that instructors were able to reserve more psychological resources allowing them to be adaptable [11]. As researchers suggest, an individual's resources are crucial for dealing with stressful situations and their emotional stability supports their ability to adapt during stressful and evolving situations [9, 12]. Consequently, there needs to be mechanisms to identify the instructors that need emotional support so that they are better able to adapt during a forced change. Future research should analyze the data at an individual level using pattern detection within the emotional data that can be triangulated with the other data collected to help identify the instructors who are in need of emotional support.

Another interpretation of the generally positive emotions instructors self-reported about teaching may indicate hesitations to report negative emotions. The relatively low number of negative emotions may be attributed to report bias wherein instructors feel they should be upbeat and role models throughout what was originally thought to be a short-term

change. Instructors may also have had an amount of fear of retribution to report negative emotions despite being informed of the confidentiality of their responses. Therefore, a better understanding of instructors' emotions each week and what may have contributed to them feeling in such a way can be garnered by delving into their specific teaching activities, successes and challenges, and perceptions of teaching during ERT [5, 14, 19].

During the first week of ERT, the greatest number of instructors reported at least one negative emotion compared to any other week. Also, during this week, the majority of instructors indicated their emotions were atypical compared to a normal semester. The atypicality of instructors' emotions may be a result of the many changes that were necessary to effectively deliver instruction remotely (e.g., new instructional materials, practices/modalities). The rapid change to ERT may have led to instructors' citing negative emotions at this time since this sudden move introduced other elements of concern all amidst personal circumstances (e.g., child-care, health concerns). According to Hodges *et al.* [2], ERT occurs quickly, making it arduous for new and/or inexperienced instructors who have not previously taught online. Therefore, this finding suggests, in an ERT situation, administration needs to provide instructors with resources that assist with life-balance.

In addition, starting in week 14, instructors were no longer allowed to use university facilities, halting any possible face-face interaction with colleagues or staff. As result of this disruption instructors had to solely rely on remote teaching and remote methods (e.g., email, videoconferencing, phone calls) to communicate. This isolation due to campus closure may have attributed to an increase in instructors' emotions in the category of Loneliness, consequently affecting their potential for adaptability. In a concurrent study, Hamad *et al.* [19] found that many instructors struggled to design and/or convert their course online. The lack of access to facilities, resources, and the ability to have casual conversations with colleagues and staff may be another explanation for instructors' feelings of Loneliness [5]. Zhou and Lin [12] assert that during changing situations, adaptability and social support are positive factors that promote psychological outcomes. Consequently, those individuals that receive higher levels of social support from their environment (e.g., colleagues, friends, and staff) are better able to adapt and have "higher levels of personal internal and external resources" [12, p. 2].

Finally, the findings of this study call for further research in instructors' adaptability. Specifically, delving into instructors' years of teaching experience and position can serve to provide a better understanding of how an instructor's teaching experience impacts their ability to adapt during a crisis [20-21]. For engineering instructors who traditionally teach face-to-face, this forced change may have been laborious, as it necessitated a redesign of courses, pedagogy, and learning technology. Thus, exploring engineering instructors' position and years of teaching experience can better guide the development of professional resources and training tools that cater to their specific needs.

This study only focused on the emotional aspect of adaptability. Future research will use other data sources (e.g., other questions in the surveys as well as interview data) to explore behavioral, emotional, and teaching cognition [5, 14,

19]. Furthermore, as data continues to be collected, exploring instructors' behavior and emotions over the course of the continued impact of the pandemic, would provide the engineering community with insight into designing support for instructor change. Understanding these dimensions and exploring any correlation among these dimensions will provide additional insight into how to support faculty development from an adaptability standpoint.

VIII. LIMITATIONS

In this study, the data collected was self-reported data and represents the emotions the instructors felt each week. Secondly, instructors from across the college of engineering were invited to participate in the study ($n=161$), however participation was voluntary. Thus, the results may not represent the emotions of the of all instructors in the college of engineering. Lastly, given the small sample size, the results of this study may not be generalizable.

IX. CONCLUSION

The COVID-19 pandemic has impacted engineering education significantly. To understand the forced transition from face-to-face instruction to ERT, this study attempted to highlight engineering instructors' positive and negative emotions pertaining to teaching, as well as the perceptions pertaining to the normalcy of these emotions. This study contributes new knowledge on instructors' ability to adapt during a forced change and can serve to identify emotional supports needed during subsequent changes to instructional practices in crisis and non-crisis times.

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