Who Benefits? Understanding the Impacts of Faculty Development Efforts on Engineering Faculty and Student Capacity through the COVID-19 Transition to Online Learning

STUDIES IN ENGINEERING EDUCATION

EMPIRICAL RESEARCH

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ABSTRACT

Background: When COVID-19 cases began rising in early 2020, many universities transitioned online.

Purpose/Hypothesis: This mixed-methods study examined how students, staff, and faculty members in a college of engineering experienced the early stages of the pandemic. We hypothesized that our prior work to build community and capacity around teaching and learning among faculty would support an empowered transition to online learning.

Design/Method: We collected 70 participant accounts from April 10 to May 28, 2020 (students = 45, staff = 2, and faculty = 24). We collected these data using the SenseMaker® online survey platform. They comprised short stories written by the participants and quantitative data resulting from participant responses to a series of questions about their experiences. We used inferential statistics to determine pivotal variables that correlated to the emotional tone of a story and differentiated faculty and student experiences. Using these pivotal variables for interpretation, we examined participant stories to identify underlying trends in faculty and student experiences.

Results: The majority of faculty members rated their stories positively (62%) while the majority of students rated their stories negatively (53%). Compared to students, faculty members reported greater opportunities, fewer struggles, higher levels of willingness to experiment, better treatment by people in positions of power, and more experiences of putting the needs of others before their own. Qualitatively, we identified two themes – ability and empowerment (or lack thereof) – to characterize the key differences between faculty and student experiences. Ability and empowerment are key facets of capacity.

Conclusions: These findings confirm our hypothesis that prior work to build community and capacity around teaching and learning *among faculty* in our college supported an empowered transition to online learning. A next step in the development of our programming is finding ways to ensure our efforts lead to increased capacity for students, too.

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INTRODUCTION

When students left for spring break in March 2020 they were expecting, like normal, to return to campus the following week. The rest of 2020, however, would turn out to be anything but normal. For many universities in the US, spring break coincided with mounting concerns over a new and particularly virulent strand of the coronavirus (SARS-CoV-2), which had originated in the Wuhan region in China. In the US, the first cases of COVID-19, the disease caused by SARS-CoV-2, were detected in late January. By mid-March, cases numbers were rapidly increasing and states and territories across the country were beginning to issue mandatory stay-at-home orders (Centers for Disease Control and Prevention (CDC), 2020b) in an attempt to "flatten the curve" and control the spread of the virus.

In the US higher-education sector, most institutions responded by shutting down in-person instruction and either moving directly online or providing faculty and students with one to two weeks to prepare for the transition to online learning (Johnson, Veletsianos, & Seaman, 2020). Although online learning has been a part of the higher-education landscape for over two decades (Álvarez, Guasch, & Espasa, 2009; Baran, Correia, & Thompson, 2011; Tallent-Runnels et al., 2006), the wholesale shift to online learning that occurred as a result of the pandemic was unprecedented.

In this article, we report on a study that investigated how students, staff, and faculty members in the College of Engineering at the University of Georgia experienced the COVID-19 pandemic – focusing on faculty and undergraduate students, who comprised the vast majority of participants. Although this research was longitudinal in nature, spanning the spring, summer, and fall 2020 semesters, here we focus on the transition to online learning that occurred during the spring of 2020. We answered the following research question: *What factors did faculty and undergraduate students report as positively or negatively impacting their ability to thrive during the COVID-19 pandemic?* The findings from this study have important implications for the future of engineering education, and particularly for STEM education centers and faculty developers working to build capacity at their institutions. More specifically, our results provide compelling evidence for the need to empower both faculty and students to experiment, take advantage of opportunities, and generally thrive during times of rapid change.

BACKGROUND

In this section, we describe three relevant contexts that foregrounded our empirical investigation. The second and third of these contexts also serve to reveal the positionalities of the authors and of the authors' relevant institutional affiliations.

KEY GLOBAL AND US-BASED COVID-19 DEVELOPMENTS & IMPACTS ON HIGHER EDUCATION

In Figure 1, we present a timeline of key global and US-based COVID-19 developments that preceded the start of our data collection on April 10, 2020. This figure (derived from CDC, 2020a) shows the progress of the pandemic from the World Health Organization's (WHO) first announcement of the virus in early January 2020, through to reports based on measures implemented in Wuhan, China, that demonstrated the effectiveness of extended periods of social distancing for flattening the COVID-19 curve. In response to these developments, the University of Georgia temporarily suspended instruction for two weeks beginning Monday, March 16, 2020, to give faculty time to transition their courses online; classes resumed in a fully online format on March 30. We began collecting data on how students and faculty members were experiencing the transition on April 10, at the end of the first two weeks of online classes.

While there are many papers that have focused on student experiences during the pandemic, few have focused on faculty experiences in parallel with student experiences, particularly within engineering. Zizka and Probst (2021) conducted a study at a business school in Switzerland and reported that aside from time, the adjustment to virtual instruction for faculty was fairly positive. Selvaraj, Radhin, Ka, Benson, and Mathew (2021) conducted a study in India with pre-collegiate

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teachers and collegiate professors and reported that many collegiate professors struggled with the transition to virtual instruction despite having more resources to connect with students compared to their pre-collegiate peers. Kedraka and Kaltsidis (2020) conducted a study in Greece with students in STEM and reported that while faculty had an easy time converting some coursework material to virtual instruction, materials related to STEM labs were more challenging. Al Miskry, Hamid, and Darweesh (2021) conducted a study in the United Arab Emirates with students, faculty, and staff, and found that all participants' mental health and physical health were negatively impacted by the pandemic. Lastly, a study similar to ours is one that was conducted by Fletcher, Jefferson, Boyd, Park, and Crumpton-Young (2023) in engineering programs at Historically Black Colleges and Universities (HBCUs) in the US. They reported that faculty experienced more challenges with instruction, research, and mentorship during the pandemic. Our contribution to the discussion about student and faculty experiences is that of a study conducted at a single institution, within the College of Engineering, simultaneously examining the experiences of students and faculty impacted by the same policies. This focus enables us to present a unique narrative regarding the impact of the pandemic on a singular case where the primary differences are the participants (faculty vs. students) who were subjected to the policies mandated by the University of Georgia and its College of Engineering.

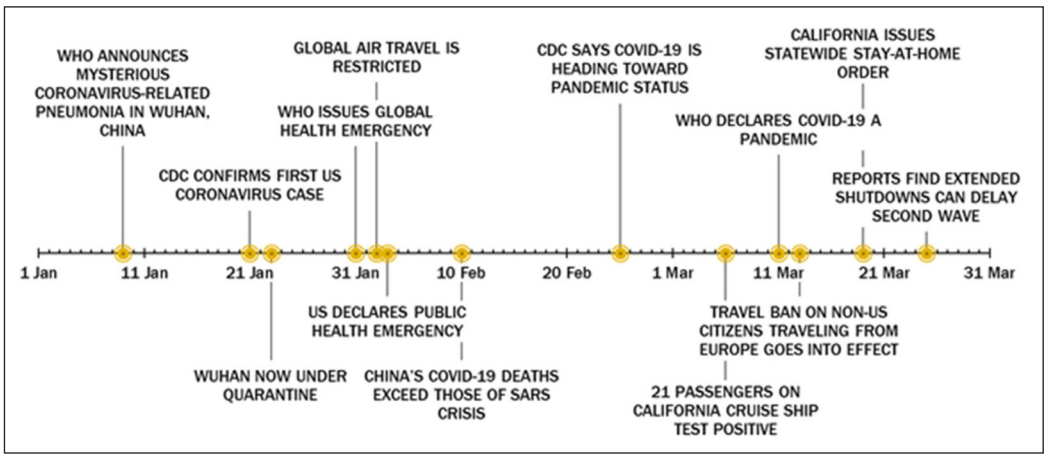

Figure 1 Timeline of early COVID-19 pandemic developments.

INSTITUTIONAL CONTEXT

We conducted this study in the College of Engineering (CENGR) at the University of Georgia (UGA). UGA is a large public university in the southeastern United States. CENGR was established at UGA in 2012. Prior to 2012, UGA offered degrees in Agricultural Engineering under the College of Agriculture. Student numbers in CENGR have more than quadrupled since 2012 (approximately 2,200 in 2021.) The number of faculty has also dramatically increased (approximately 100 in 2021).

In order to support the growth of our college, the professional development of new and legacy faculty, and the continued quality of our undergraduate and graduate programs, in 2016 the second and sixth authors established the Engineering Education Transformations Institute (EETI). EETI is an academic unit that sits across the three interdisciplinary schools in CENGR. Its mission is to build social capital, community, and capacity around scholarly teaching and engineering education research.

EETI coordinates a range of programming in support of this mission, including monthly college-wide forums, weekly peer-mentoring meals, Faculty Learning Communities (FLCs), book clubs, research incubators, research initiation grants, and travel fellowships to education conferences. These elements of EETI programming provide opportunities for graduate students, staff, and faculty to build community around common areas of interest, connect to internal and external experts, and develop early ideas into actionable teaching and research projects.

When COVID-19 hit in early 2020, EETI was in its fifth year of programming and was experiencing faculty and staff participation rates of approximately 60% across the college (Engineering

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Education Transformations Institute, 2020a). This community provided our research team with the social capital required to respond quickly and effectively to the impacts of COVID-19 on teaching and learning in the college. For example, the first author immediately began coordinating well-attended faculty mentoring sessions and translated questions from these sessions into an open resource for online learning (Engineering Education Transformations Institute, 2020f). This community was also instrumental in ensuring that we received sufficient buy-in and participation in our study, particularly from faculty members.

EETI was designed based on a number of theories and principles related to complex systems theory, many of which are described in detail elsewhere (Morelock, Sochacka, & Walther, 2020; Morelock, Walther, & Sochacka, 2019; Secules, Bale, Sochacka, & Walther, 2018; Sochacka, Walther, Morelock, Hunsu, & Carnell, 2020). Most critical to this study is EETI's commitment to building instructional capacity through the creation of interconnected learning communities of faculty. Drawing from several scholarly sources, we define *instructional capacity* as the ability and empowerment of system actors (faculty, staff, and students) to adapt to changing instructional needs and collectively achieve shared instructional objectives (Bain, Walker, & Chan, 2011; Baser & Morgan, 2008; Brinkerhoff & Morgan, 2010; Stoll, 2009). For example, during the early weeks of the COVID-19 pandemic, instructional capacity manifested as the extent to which faculty, staff, and students had the skills and knowledge (ability) to successfully achieve the shared objective of providing quality online learning, and the extent to which they were empowered to apply the knowledge and skills to instruction effectively in the face of a sudden change in their educational environments (e.g., through sufficient transition time and administrative support.) The construct of capacity is strongly linked to the construct of adaptability at both an individual (Granziera, Collie, & Martin, 2019; Gregor et al., 2021) and organizational level (Uhl-Bien & Arena, 2018), with several authors describing adaptability as a hallmark outcome of high-capacity organizations (Bain et al., 2011; Stoll, 2009). One major difference is that capacity literature focuses on the development of self-organizing communities to anticipate organizational needs and work together to achieve them, while adaptability literature focuses on improving individuals' adaptability or leading in such a way to promote individuals' empowerment to adapt. We elect to focus on the construct of capacity over the more well-studied construct of adaptability because EETI's approach to educational development revolves around the creation of self-organizing communities of instructors.

Particularly, EETI builds instructional capacity by creating and supporting multiple communities devoted to organizational learning around engineering education across our College of Engineering. We structure these communities in alignment with the framework for connecting learning communities offered by (Stoll, 2009). This framework prioritizes creating spaces that empower faculty to collaboratively inquire about new educational practices and apply their newfound knowledge in the form of iterative instructional experiments. Along the way, faculty support one another in implementing new instructional projects, share the results of their work with colleagues in the College, and engage in meta-learning with peers to determine which innovations are a good fit for UGA's instructional context and why.

THE RESEARCH TEAM: OUR ROLES IN THE COLLEGE AND OUR DEVELOPING METHODOLOGICAL EXPERTISE

This study was conducted by a core team of four faculty members and two undergraduate student researchers. Three of the four faculty members make up the leadership team for EETI (the first, second, and sixth authors). All four faculty members teach in the college and conduct research in engineering education. The two undergraduate student researchers were pursuing degrees in mechanical engineering at the time of the investigation. In the context of this study, therefore, the team could be considered as insiders or participant observers (Herrmann, 1989), in the sense that we were part of the system under investigation. An additional team of nine faculty members and five students participated in the interpretation of the data as critical friends. Specifically, the core team conducted a preliminary analysis of the data and then presented their findings to the faculty members and students and invited them to engage with and question the interpretations. This process took place during two 2-hour meetings and involved access to the SenseMaker dashboard

(see Figure 4), a visual data interface that enables real-time exploration and visual representations of raw data and correlations between variables. The core team then integrated this feedback into the two reports that were published to share the study findings with members of the College (Engineering Education Transformations Institute, 2020b, 2020c).

METHODS

We employed a primarily qualitative, concurrent, mixed methods research approach (Creswell, 2009) using a data collection and analysis platform called SenseMaker to examine how members of the College of Engineering at the University of Georgia experienced the COVID-19 pandemic and transition to online learning. The goals of the study were to, first, understand student, staff, and faculty experiences; second, provide real-time recommendations designed to amplify positive experiences and dampen negative experiences; and third, to extract transferable lessons that could inform engineering education post COVID-19, both in our college and more broadly. The first two goals were accomplished through a practice-oriented publication and a series of public reports addressed to College of Engineering faculty, students, and administration (Engineering Education Transformations Institute, 2020b, 2020c, 2020d, 2020e; Morelock, Sochacka, Lewis, et al., 2020). This paper addresses the third goal. We received RAPID funding from the National Science Foundation to conduct this research. The study was approved by UGA's IRB office under protocol ID PROJECT00002157.

SenseMaker is a method designed to inquire into and change, for the better, complex social systems. A college of engineering is an example of such a complex, social system. SenseMaker works by collecting stories from within a system and then posing the question "What changes can we make to the system to create more positive stories and fewer negative ones?" The creators of SenseMaker refer to these actions as "probing" a system to learn more about it, and then "nudging" it in a desired direction or set of desired directions (Sochacka, Culloty, Hopkins, Harrell, & Walther, 2020; Van der Merwe et al., 2019).

Prior work has described SenseMaker described as a "mixed method that combines first-hand narratives with the statistical authority of quantitative data" (Van der Merwe et al., 2019, p. 3). Narratives, or short stories, are what make up the qualitative data in a SenseMaker project. They are collected via an online platform that includes an open-ended prompt designed to encourage participants to share an experience they have had recently in such a way that is not influenced by a priori theory. We asked participants to respond to the following prompt:

> Imagine you are meeting a friend. Tell them about something you have experienced recently as a student, faculty or staff member since the COVID-19 outbreak and transition to online learning.

The quantitative data comes from how participants make sense of their own stories. This capability is one of the distinguishing features of the SenseMaker approach. In effect, participants conduct the first level of data analysis on their own data. They do so by answering a series of questions that are part of what is called a "signification framework" (Van der Merwe et al., 2019, p. 3), based on a theory selected by the research team.

SenseMaker signification frameworks comprise three different types of questions: triads (typically six), dyads (typically two or three), and multiple-choice questions. After each participant tells their story, and gives their story a title, they are asked to make sense of their experience by moving the dot on a triad like the one in Figure 2 to the position that best fits with their story. We note that participants are also given the choice to select "not applicable" for each triad and dyad).

Van der Merwe et al. (2019) described triads and dyads as "relational filers…which capture nuances in the experiences of participants that traditional surveys cannot convey" (p. 6). They further discuss how the "deliberate ambiguity among options in the signification framework invites people to exercise their own judgement, which triggers slow thinking and retrospective sensemaking" (p. 6). In addition to prompting participants to meaningfully interpret their story

relative to three different concepts, triads also serve to shorten surveys because three concepts are probed in one question, thereby reducing the burden on participants.

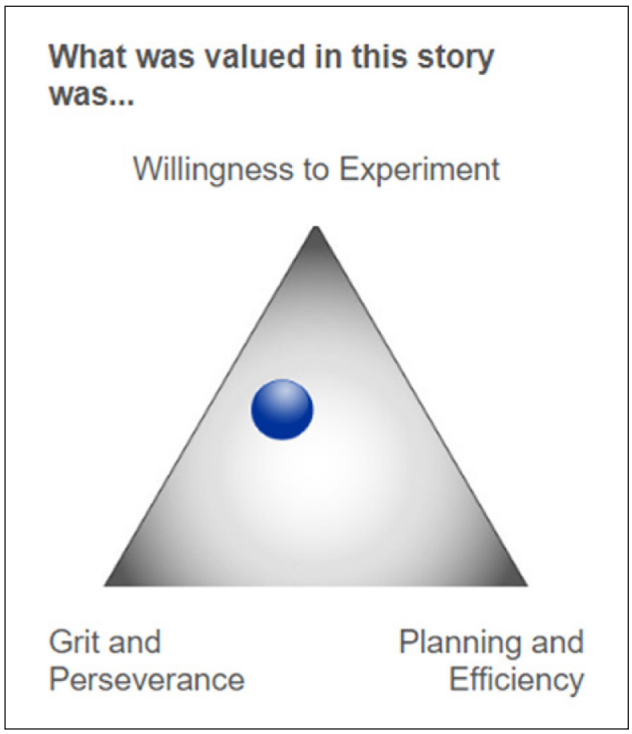

Figure 2 Example of a triad included in the data collection instrument.

The second type of question participants use to interpret their stories is called a dyad. An example from our study is illustrated in Figure 3. Dyads typically map out a space between two extremes (Van der Merwe et al., 2019), where the ideal response is meant to lie in the middle of the two extremes (Van der Merwe et al., 2019). Dyads work in a similar way to triads; participants move the dot to the place on the line that best fits their story.

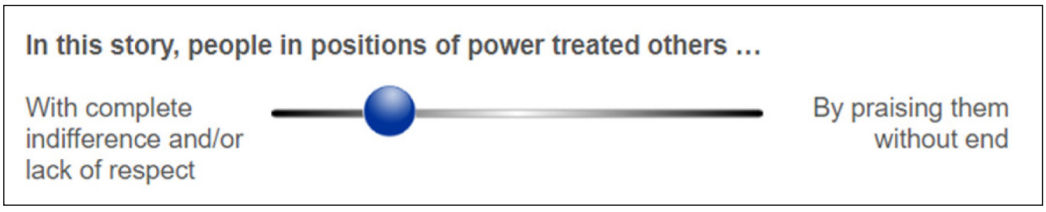

Figure 3 Example of a dyad included in the data collection instrument.

Multiple-choice questions comprise the third type of question in a signification framework. Participants' responses to these questions can be used to filter the data during analysis. Of interest to this study, we asked participants to self-identify as faculty, staff, undergraduate students, or graduate students. We also asked participants to respond to the question, "How do you feel about your experience?" with the options, (1) Extremely Positive, (2) Positive, (3) Neutral, (4) Negative, or (5) Extremely Negative.

While this paper ultimately reports on insights related to capacity building, we did not initially design our study with capacity in mind. Rather, our signification framework was based on the concept of thriving (Tobias, 2004; Schreiner, 2013) because we wanted to understand how faculty, staff, and students thrived or failed to thrive in conditions of sudden and extreme change.

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We followed best practices[1] for developing the triads and dyads in our study. Specifically, we reviewed literature on thriving to identify concepts that could be translated into the triads and dyads in our signification framework. Tobias (2004) proposed the following nine dimensions to examine parallels and linkages between thriving individuals and thriving organizations: Initiative, Discipline, Accountability, Investment, Openness/ Reflectiveness, Flexibility, Autonomy, Alignment with Others, Internal Alignment. Schreiner (2013) further discussed how creating a sense of community is an important foundation for thriving. Next, we familarized ourselves with the characteristics of effective triads and dyads by consulting with the creators of SenseMaker and reviewing prior SenseMaker studies. For example, when designing a triad, it is important that all three concepts on the corners of the triangle have a similar emotional tone and that there are no obviously right or wrong answers. Finally, we piloted our signification framework with students and faculty in our research group and integrated their feedback to further refine the survey. The six triads and two dyads we used in our study are presented in Table 1.

Table 1 Triads and dyads used in the SenseMaker signification framework (i.e., data collection instrument), including the thriving concepts from Tobias (2004) and Schreiner (2013) that informed each question.

TYPE	PROMPT	ANCHORS	THRIVING CONCEPT(S)
Triad	This story was about...	Struggle, Opportunity, Progress	Thriving (overarching concept) + Accountability (sub-feature)
	What was valued in this story was...	Willingness to experiment, Grit and perseverance, Planning and efficiency	Initiative, Investment, and Discipline
	Actions were in the story were motivated by...	Expectations of others, Self-care, Rational decision-making	Autonomy
	The decisions that were made in this story were influenced by...	Intuition, Self-reflection, Feedback from others	Openness/ Reflectiveness
	The experience I shared influenced impacted my (or the person in the story's) sense of...	Confidence, Purpose, Belonging	Internal alignment and Alignment with others
	Thinking about the future, this story encourages me to...	Embrace risk, Be willing to adapt, Have a "can do" attitude.	Initiative and Flexibility
Dyad	In this story I (or the person in my story) decided...	To put myself first – my interests are most important ↔ To put others first – my own interests aren't important	Sense of community – interdependence, shared goals
	In this story, people in positions of power treated others ...	With complete indifference and/or lack of respect ↔ By praising them without end	Sense of community – voice and contribution, mattering to the institution

In addition to providing a data collection platform, the SenseMaker package also includes data visualization and analysis capabilities, that is, a "data dashboard." When we see the data on the dashboard, it looks like the screenshot shown in Figure 4. Each dot represents one story. One can use the software to highlight clusters of stories. For example, in Figure 4 we have selected stories in Grit and Perseverance corner of this triad. The titles of the stories within the selection are on the left-hand side of the figure. If we were to click on one of these titles, we would be able to read the participant's story. Finally, we note that there was also a permission question in the survey. If participants did not give permission to read their story, we could see the title they gave their story and the associated quantitative data in the triads, dyads and multiple-choice questions but not the original narrative.

1 We note that since conducting this study, further best practices have emerged around designing effective signification frameworks. For further information on these processes, we recommend that readers contact Paul Adler from Think Clarity at paul.ader@thinkclarity.co.uk.

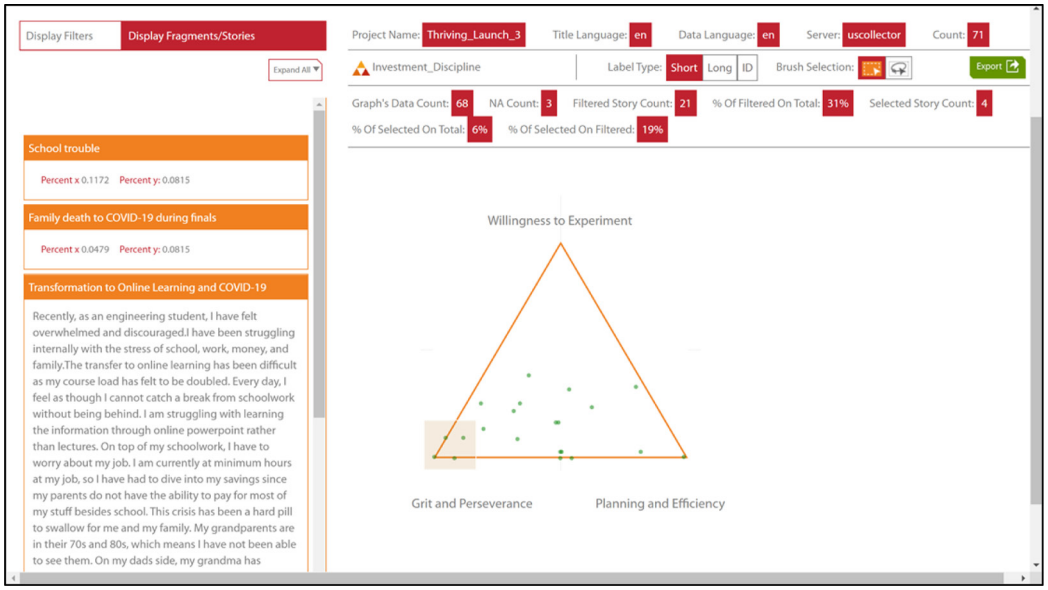

Figure 4 Snapshot of SenseMaker's data analyst software.

We used Sensemaker to collect 70 stories during the spring 2020 semester from April 10 to May 28, 2020 (faculty = 23, staff = 2, undergraduate students = 31, graduate students = 14). Faculty were significantly more represented compared to staff and students. Although we cannot confirm accurate response rates due to the anonymity of responses and ability of participants to submit multiple responses, we estimate that faculty response rates were close to 25%, compared to estimated staff response rates of 4% and estimated student response rates of 1%. While the staff response rate was higher than for students, the data from students was richer, that is, 45 stories and associated quantitative data points for undergraduate and graduate students versus two stories and associated quantitative data points from staff members. For this reason, we do not comment on staff experiences in our results. Although, in a purely quantitative study, a response rate of 1% for students may be cause for concern, we decided to proceed with a comparative, mixed methods analysis of faculty and student experiences for two reasons. First, our early efforts to publish our preliminary findings in a series of public reports addressed to College of Engineering faculty, students, and administration resonated with these audiences and prompted changes in how faculty, students, and administration managed teaching and learning in this stage of pandemic. The level of resonance we observed with these stakeholders led us to trust the data we were able to collect during what was arguably one of the most tumultuous times of the pandemic. Therefore, instead of dismissing the data because of the comparatively low response rate among students, we decided to proceed with an acknowledgement of this limitation, and we caution readers against attempting to generalize our findings beyond the study context.

We analyzed the quantitative data using a sequential mixed methods approach (Creswell, 2009), using inferential statistics to analyze triad, dyad, and emotional tone data, which allowed us to identify pivotable variables that served as analytical lenses for a deeper, qualitative analysis. Below we describe specific analysis methods along with their relevant results. For quantitative analyses, a result was considered significant at $p = 0.05$.

RESULTS

These findings describe how students and faculty experienced the early stages of the pandemic and transition to online learning. When we asked participants how they felt about their experiences, the majority of faculty members coded their stories as positive (15 out of 24; 62%) while the majority of students, combining undergraduate and graduate students, coded their stories as negative (24 out of 45; 53%).

To corroborate the findings from Table 2, we conducted a t-test to see if faculty and students differed, on average, in the emotional tones of their stories (i.e., how the participant rated their

story along the five-point Likert scale from "Extremely Negative" to "Extremely Positive"). The test revealed that faculty, on average, rated their stories 1.14 scale points higher than students (i.e., slightly more than a full Likert point more positive), a result that was significant at p=0.01. Following this result, we sought to identify which dimensions of thriving affected faculty and student experiences the most during the early stages of the pandemic and the transition to online learning. We did so by analyzing participants' quantitative ratings along the dimensions of each triad and dyad to identify (1) which dimension ratings significantly correlated to the emotional tone of a story, and (2) which dimension ratings significantly differed between faculty and students. All quantitative analyses (including the t-test described above) were conducted in JMP.

	UNDERGRADUATE	GRADUATE	FACULTY	STAFF
Extremely Positive	3	1	5	
Positive	2		3	1
Neutral	2	3	2	
Negative	6	1	2	1
Extremely Negative	3	1		

Table 2 How participants felt about their experiences on a five-point Likert scale from Extremely Negative to Extremely Positive. Each whole person icon represents two participants. The appendix includes a numerical version of this table.

To find correlations between triad/dyad ratings and emotional tone, we modeled each dimension using a separate linear regression model in JMP to identify if the slope between emotional tone (independent variable, Likert scale of 1–5) and the dimension rating (dependent variable, continuous scale from 0–100) was significant. Table 3 displays our results and shows that several triads and both dyads significantly correlated with emotional tone.

To find differences in ratings between faculty and students, we conducted a MANOVA for each triad and an ANOVA for each dyad to determine which triads and dyads were rated significantly differently by the two groups. For each triad where the MANOVA test was significant, we identified which specific dimensions of the triad returned a significant result in terms of differences between group means. Table 4 displays our results and shows that several triads and both dyads were rated differently by students and faculty.

We combined the results of these two analyses to identify dimensions of thriving that both differed between faculty and students and significantly correlated to emotional tone. We interpreted these dimensions to be pivotal variables in understanding why faculty experiences were more positive than those of students.

PIVOTAL VARIABLE: OPPORTUNITY VERSUS STRUGGLE

The first of these pivotal variables resulted from the first triad, which asked participants to respond to the prompt "This story was about…", using the anchors "Opportunity," "Struggle," and "Progress." Opportunity and Struggle – but not Progress – emerged as significant in our quantitative analyses. More specifically, stories that participants rated as being strongly about Opportunity

were more likely to be positive and provided by faculty, while stories participants rated as being strongly about Struggle were more likely to be negative and provided by students. Figure 5 displays these triad results visually.

TRIAD	DIMENSION	SLOPE ESTIMATE	SIGNIFICANCE (P)
This story was about...	*Opportunity*	*+9.25*	*<0.001*
	Struggle	*–16.56*	*<0.001*
	Progress	*+7.31*	*<0.001*
What was valued in this story was...	*Grit & Perseverance*	*–6.53*	*0.005*
	Willingness to Experiment	*+8.16*	*<0.001*
	Planning and Efficiency	–1.63	0.47
Actions were in the story were motivated by...	Rational Decision Making	+3.13	0.12
	Expectations	–1.56	0.51
	Self-Care	–1.56	0.51
The decisions that were made in this story were influenced by...	*Self-Reflection*	*–4.89*	*0.03*
	Intuition	+0.04	0.98
	Feedback	*+4.84*	*0.04*
The experience I shared influenced impacted my (or the person in the story's) sense of...	Purpose	+2.15	0.34
	Confidence	–0.75	0.73
	Belonging	–1.40	0.52
Thinking about the future, this story encourages me to...	Embrace risk	+1.50	0.24
	Be willing to adapt	–1.61	0.49
	Have a "can-do" attitude	+0.11	0.96
DYAD	**DIMENSION**	**SLOPE ESTIMATE**	**SIGNIFICANCE (P)**
In this story I (or the person in my story) decided...	*Put myself first ↔ Put others first (High = Put others first)*	*+10.22*	*<0.001*
In this story, people in positions of power treated others ...	*Lack of respect ↔ Praise without end (High = Praise without end)*	*+17.11*	*<0.001*

Table 3 Results of linear regression tests between each dyad/triad dimension and emotional tone of participants' stories. Slope estimate indicates how much the rating for a given dimension would change, on average, for each subsequently more positive emotional tone rating (significant dimensions are bolded).

This finding adds nuance to the differences faculty and students reported in the emotional tone of their stories. Below, we highlight examples of qualitative insights by providing excerpts from participants' stories with particularly high or low Opportunity scores compared to their Struggle scores. We also provide the scores that show how the participants rated their story on the scale of extremely negative to extremely positive.

When we examined the qualitative data associated with positive stories with high Opportunity scores, we noticed that faculty repeatedly described opportunities to help students, primarily through thoughtfully considering and reflecting on their teaching practices. The story below from a faculty member illustrates this kind of opportunity. Here the participant described using the pandemic as a means to learn about teaching diverse students and to show empathy during a unique instructional situation. All stories are presented as written, with titles given by participants, emphases added from the research team to highlight key insights, and some parts cut for brevity—denoted via [...].

TRIAD (INCLUDING MANOVA SIGNIFICANCE)	DIMENSION	DIFFERENCE IN MEANS (FACULTY – STUDENT)	SIGNIFICANCE (P)
This story was about... (p = 0.004)	*Opportunity*	*+13.59*	*0.005*
	Struggle	*–16.22*	*0.03*
	Progress	+2.63	0.54
What was valued in this story was... (p = 0.02)	Grit & Perseverance	–0.59	0.93
	Willingness to Experiment	*+14.49*	*0.02*
	Planning and Efficiency	*–13.90*	*0.03*
Actions were in the story were motivated by... (p = 0.27)	Rational Decision Making	MANOVA not significant	
	Expectations	MANOVA not significant	
	Self-Care	MANOVA not significant	
The decisions that were made in this story were influenced by... (p = 0.06)	Self-Reflection	MANOVA not significant	
	Intuition	MANOVA not significant	
	Feedback	MANOVA not significant	
The experience I shared influenced impacted my (or the person in the story's) sense of... (p = 0.08)	Purpose	MANOVA not significant	
	Confidence	MANOVA not significant	
	Belonging	MANOVA not significant	
Thinking about the future, this story encourages me to... (p = 0.02)	Embrace risk	+2.14	0.55
	Be willing to adapt	+12.08	0.06
	Have a "can-do" attitude	*–14.22*	*0.02*
DYAD	**DIMENSION**	**DIFFERENCE IN MEANS (FACULTY – STUDENT)**	**SIGNIFICANCE (P)**
In this story I (or the person in my story) decided...	*Put myself first ↔ Put others first (High = Put others first)*	*+14.17*	*<0.001*
In this story, people in positions of power treated others ...	*Lack of respect ↔ Praise without end (High = Praise without end)*	*+37.27*	*<0.001*

Table 4 Results of MANOVA/ANOVA tests identifying differences between faculty and student ratings along each dyad and triad. A positive difference in means indicates faculty had higher ratings than students (on average), and vice versa.

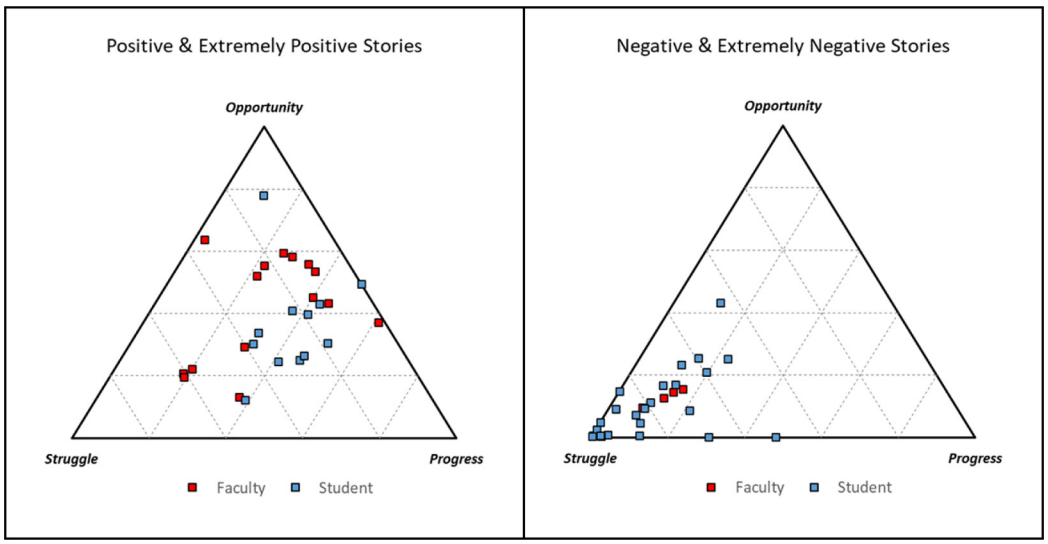

Figure 5 Triad results for the prompt "This story was about..." for positive-leaning (left) and negative-leaning (right) stories. Each data point represents one story.

Example story from a faculty member, Opportunity 56/100, Struggle 11/100, Extremely positive

> **Balancing work and life: A tale of two teachers**
>
> My experience learning to home school two children while also teaching graduate students has been extremely eye opening. My wife and I take turns with home school responsibilities because we both work and there are many days where I am teaching two kids [the] basics of numbers and [the] alphabet and then teaching graduate students advanced [name of technical course]. *I have really come to notice that there are many similarities, but also some small differences in how to approach these different types of students. I have been most fascinated by the similarities, mainly the effectiveness of compassion and encouragement.* The differences mostly arise in how I approach the student (my daughter or a graduate student). The experience has really been rewarding for me overall and while I wish I could meet with my [name of course] students in person (invaluable based on my experiences over the past month or so), I feel like they have responded well. *I did make an effort to ensure coursework was not overly demanding and have remained flexible with each as I regularly do even not during unique situations.* [Emphases added.]

Students, on the other hand, described multiple experiences of struggling to adapt to the online environment. Only a small number of students perceived the pandemic as an opportunity to learn differently or reflect on broader feedback. Students commonly described a disorderly transition to online learning, increased workload, inflexible policies, or increased personal and family-related stress as common sources of struggle. One student succinctly described all of these factors as contributing to a high-stress learning environment once the pandemic began:

Example story from an undergraduate student, Opportunity 0/100, Struggle 99/100, Negative

> **The struggle to transition**
>
> The disorder of transitioning to online classes made the Cov-19 experience much worse. *Some professors uploaded lectures, videos and even exam grades late, but still demanded their assignments to be due at the time stated on the syllabus.* The distribution of work was either way more than before, because online class was deemed as easier, or less work to help us deal with personal situations. This caused a lot of confusion for me personally because I didn't have the resources I once had, but I was still required to perform at the same standard. Once the University decided to keep the traditional grading methods, that caused me to become more anxious because a few of my professors let us know that there would be no curve in place. *It seemed as if only a few faculty members cared about what was happening in the world.* Overall, this change was very stressful and I didn't feel like I was receiving much help with dealing with it. [Emphases added.]

We note, however, that not all students found the struggle associated with online learning to outweigh new opportunities. One student, for example, described leveraging outdoor activities to draw real-world connections to her fluid mechanics course:

Example story from an undergraduate student, Opportunity 41/100, Struggle 22/100, Extremely positive

> **Tiny dog, huge breakthrough**
>
> [...] Our lecture was on boundary layers and I was frustrated about the directionality of flow and how to calculate the sheer stress. It seemed complicated looking at the video and my brain started to shut off. When the Zoom lecture was over, I closed my laptop and decided to go for a walk to clear my head. I'm very lucky to live by [name of] Park and the small river that runs through it. Power walking, I stopped to observe a small dog playing in the stream. Interesting, I thought. The water flows around him and I can see the distinct change to turbulent flow from steady flow depending on the angle he was standing. The little dog had more trouble fighting the current when he was

facing the flow, as opposed to sideways. Less area for the force to be distributed over, I pondered. It was then I realized exactly how important learning outside of one's normal environment was. *The lecture had clicked in my brain thanks to a tiny dog swimming in the river. While remote learning wasn't what I signed up for, I am lucky to have the facilities to continue to learn and the understanding and excellent lectures* of [instructor's name]. Getting outside is just as important as studying in this stressful time. [Emphases added.]

Overall, stories associated with Opportunity and Struggle revealed that recognizing or leveraging new opportunities during the transition to online learning required an environment without intense levels of stress and struggle, and revealed that faculty were better supported to experience such an environment. This finding was further reinforced when investigating other pivotal variables.

PIVOTAL VARIABLE: WILLINGNESS TO EXPERIMENT

Another interesting pivotal variable was *Willingness to Experiment* (WtE) in response to the triad prompt, "What was valued in this story was…". Stories where participants indicated WtE was more strongly valued were more likely to be positive, and faculty were more likely to make this indication. Figure 6 displays these triad results visually.

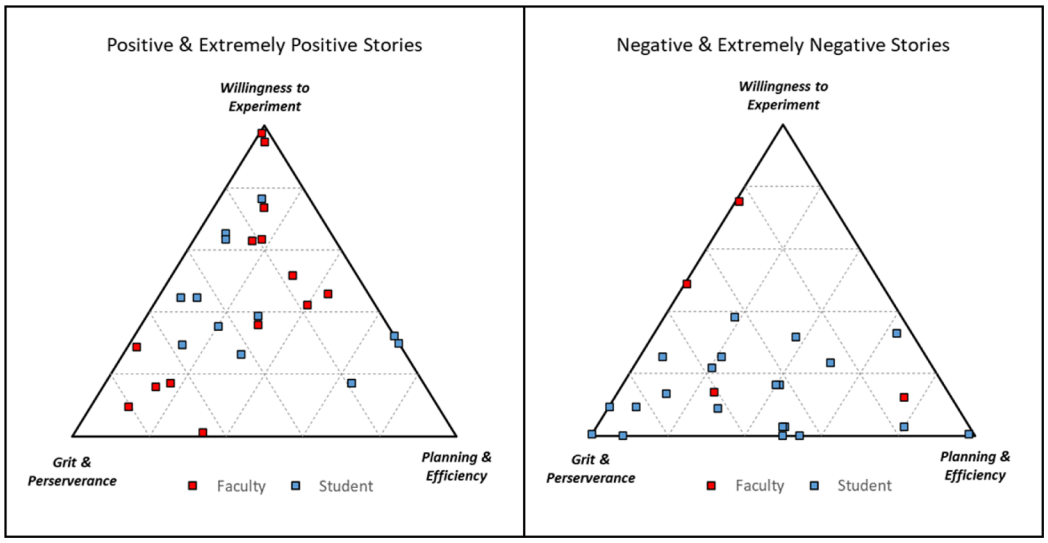

Figure 6 Triad results for the prompt "What was valued in my story was…" for positive-leaning (left) and negative-leaning (right) stories. Each data point represents one story.

When we qualitatively analyzed faculty and student stories that had high versus low WtE ratings, trends emerged that were strongly related to the ability and empowerment of participants to explore new opportunities afforded by the transition to online learning. In examining faculty stories, it became apparent that the transition to online learning empowered many of them to try new things in the classroom. The first story discusses a faculty member's decision to experiment with oral exams during the transition to online learning because "the stakes [were] lowered by a pandemic."

Example story from a faculty member, Willingness to Experiment (WtE) 63/100, Positive

Transitioning to online exams

This story is about my transition to trying oral exams for [name of technical course]. I have believed for a few semesters that the traditional exam process is not used for the right reasons. I don't think exams actually assess what faculty seem to think they assess. And I think educational experiences should model professional experiences so that students have an opportunity to practice that which they will be asked to perform in the real world--and practicing engineers are rarely if ever asked to sit by themselves and quietly work on a series of problems for an hour or two. So *I've wanted to try giving*

> *oral exams for [a] while*. It's not a perfect solution, but I think it's better than traditional exams in many ways. *This semester, I decided to give each of my students the option of taking a more traditional exam online during our class time or taking an oral exam* during a 20-minute time slot of their choosing. Ten of my seventy students opted for the oral exam. These are ten of my better performing students. I have given one oral exam to-date. I think it went really well! [...] I knew I wanted to try oral exams for about a year now, but I was scared to try it out. The fact that this semester has already been affected by COVID-19 helped me to try out this new approach finally, because *it's easier to try something new that might fail when the stakes have been lowered by a pandemic.* [Emphases added.]

The following story provides an example of a faculty member who worked to balance connecting with students with the challenges of online learning environments, in this case perceived bandwidth limitations.

Example story from a faculty member, WtE 64/100, Positive

> **The importance of face-to-face interaction**
>
> Briefly, I had everyone turn their video on so they could say hi to each other for my first class after returning from the extended break. *Normally I keep video for students off to save on bandwidth and prevent slowdown of material, but I thought this was nice* since I have not seen them for weeks and do not get to regularly see their faces. I think they appreciated it as well and many of them were smiling and wanting to show their living situation (and pets!) [Emphases added.]

Students' stories, on the other hand, revealed that students' relatively low WtE was not due to a lack of empowerment compared to faculty, but rather due to a lack of ability to spare time or capacity for experimentation among the many anxieties and tasks the pandemic introduced. The next two stories are examples of the kinds of experiences that students rated as negative. Both stories have very low WtE scores and describe experiences of struggling to cope with learning in an online environment and life during a pandemic.

Example story from an undergraduate student, WtE 3/100, Extremely Negative

> **The juggle struggle**
>
> Online learning has been a fairly frustrating experience, and I am having an issue with one engineering class specifically. *I personally benefit from in person instruction very much, so trying to learn everything online has been very difficult.* The one class I mentioned has stopped direct instruction almost entirely, which leaves us to learn from the online textbook (which I never found very helpful) and other online resources that we find ourselves. This is very frustrating, especially since multiple grades are being taken every single week, and the content is considerably difficult in the first place. Combined with juggling my other classes, it has been a struggle to try to keep up with this class. I have to divide my attention between five or six other classes, so *I don't have the time to spend 3+ hours every day to teach myself the content in its entirety.* It feels like I've just been watching my grades drop over this period of online learning. It's frustrating and I'm not really sure how to fix it. [Emphases added.]

Example story from an undergraduate student, WtE 0/100, Negative

> **Transformation to online learning and COVID-19**
>
> Recently, as an engineering student, I have felt overwhelmed and discouraged. I have been struggling internally with the stress of school, work, money, and family. The transfer to online learning has been difficult as my course load has felt to be doubled. *Every day, I feel as though I cannot catch a break from schoolwork without being behind. I am struggling with learning the information through online PowerPoint rather than lectures.* On top of my schoolwork, I have to worry about my job. I am currently at

> minimum hours at my job, so I have had to dive into my savings since my parents do not have the ability to pay for most of my stuff besides school. This crisis has been a hard pill to swallow for me and my family. [Emphases added.]

These two aspects of faculty and student experience—empowerment and ability—have strong presence in faculty and student stories in terms of both WtE and Opportunity vs. Struggle, and we explore these themes further in our discussion.

PIVOTAL VARIABLE: PEOPLE IN POSITIONS OF POWER

The third pivotal variable was how participants responded to the dyad, "In this story, people in positions of power treated others…". Participants responded on a spectrum from 0 to 100, with 0 indicating "With complete indifference and/or lack of respect" and 100 indicating "By praising them without end". We refer to this dyad as the "People in Power" dyad, or PP for short. This pivotal variable was the dimension of thriving that had the highest correlation to emotional tone, a correlation made apparent in Figure 7.

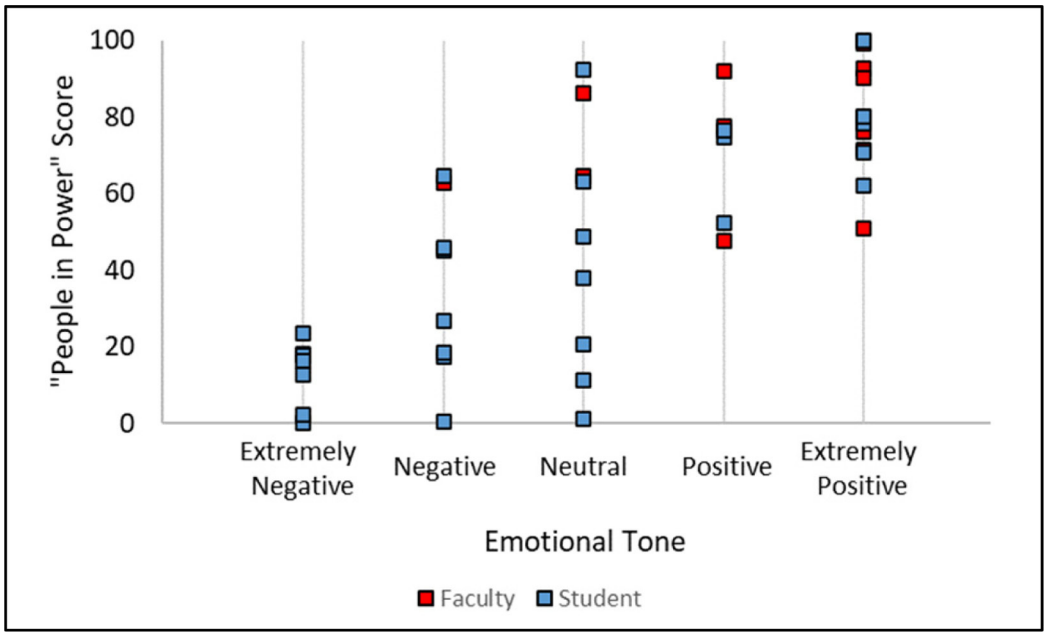

Figure 7 Relationship between People in Power (PP) score and emotional tone rating.

Again, participant responses to this question revealed significant differences between faculty and student experiences. Where a score of 100 indicates a perception that people in positions of power treated the participant "by praising us without end," the average faculty score was 77 while the average student score was 41. Moreover, the average score for extremely positive and positive faculty stories was 80; while the average score for extremely negative and negative student stories was 20.

Qualitative analysis of undergraduate student data revealed that low PP scores were largely the result of students feeling they were on the "receiving end" of decisions made by the institution or their instructors, having little empowerment to exercise in terms of their learning during the pandemic. One student clearly articulated how inflexible instruction combined with inflexible institutional policies to create an overall sense of disempowerment during the pandemic:

Example story from an undergraduate student, PP 2, Extremely Negative

> **The stressful and frustrating story of a transfer student**
>
> I am a second-year transfer student who transferred from [name of institution]. I did not get into the engineering major right off the bat, so I'm retaking several classes to get higher grades. One of those classes is [name of technical course]. Most of my grade in that class (~80%) depends on the four tests we take. We had taken two tests before

> the pandemic, and I had an A test average. A large portion of the grade from those tests came from partial credit. *Once the pandemic started, our professor decided to make the new tests have no partial credit.* The third test I took in that class was our first online one, and the first test not to offer partial credit. I scored a 33% on that exam. Had partial credit been offered, I am confident that I would have scored at least a 70%. I consider it extremely unfair that the grading standards for tests has been changed mid-semester. I am also retaking Calculus 2, and I have been able to maintain my "A" in that class for the sole reason that the professor created a system for partial credit. *The fact that one of my professors has adapted to continue offering partial credit on tests and another has not only added to my frustration.* The stressful situation of the pandemic has been made even more stressful by this problem that has an obvious solution. The reason I am so stressed by this is because my admission into an engineering major is riding mostly on my [name of technical course] grade. Because students only have two tries to get into the major, and I was rejected from the major once already, *this is my last chance to major in engineering at the University of Georgia.* [...] This factor has made scoring a 33% on that one test extremely stressful to me. If I am not accepted into an engineering major at the University of Georgia, I will be forced to transfer back to [the school I transferred from] to complete an engineering degree. I know that this is what I want to major in, and I have been successful in the major before. Being forced to do this would be more the result of a systematic failure of the University of Georgia, specifically the College of Engineering, rather than failure on my part. [Emphases added.]

On the other hand, undergraduate student stories with high PP scores spoke of instructors who took time to give students some element of empowerment over their learning and assessment, or of faculty members who consulted students when making course-related decisions. For example, the next story demonstrates how asking students for their opinions on course-related decisions made students feel more "connected and valued."

Example story from an undergraduate student, PP 78, Extremely Positive

> **Communication is key!**
>
> One of my professors has done particularly well during this transition at asking students for their opinions on things such as the course workload and assignment due dates. Students were able to voice these opinions in weekly zoom conferences scheduled during our typical course meeting time. Gathering opinions can seem messy and time consuming, but our zoom conversations went smoothly [and] were rather succinct. I found this professor's approach particularly refreshing because it differs from the more common approach of instructors making unilateral decisions and simply leaving the course evaluations as the way for students to express their opinions. *At a time when things are in such flux, it just seems logical to consult all of the stakeholders (students!) before making decisions about the course trajectory.* Furthermore, it helped students to feel connected and valued, and that is quite important at a time like this. [Emphases added.]

The final two stories show how students appreciated faculty members who redesigned their assessments to provide meaningful choice to students.

Example story from an undergraduate student, PP 77, Positive

> **Finals during a pandemic**
>
> My experience with finals this semester was positive because several of my courses did not implement a cumulative final, as originally planned; this allowed me to focus on the material that was difficult to grasp since courses were moved online. One of my engineering elective courses *switched our final exam with a final paper with a topic of our choice*; having a topic of interest was extremely helpful with completing the assignment. *Having understanding faculty has eased my experience as timed [sic] progressed in online courses.* [Emphases added.]

Example story from an undergraduate student, PP 75, positive

Change of pace

In a typical semester, finals week is often pretty grueling. Engineering professors almost always give 3-hr exams for their final, so I would end up with 4-5 when students from other majors would get 2-3. Even without the outbreak, this semester was really stressful, and I was not looking forward to it. Luckily, the outbreak caused the professors to reorganize their finals, and one of them chose a novel approach: rather than a tough exam for an engineering elective-level class, he made it a project with several options. We could write a report on engineering case studies, write a critique of a chapter from a textbook he was working on, or solve an extended problem using both analytical and numerical methods. *What amazed me is the breadth of the project. Since students have different strengths, they can choose the option that best compliments their abilities, and I would like to see this sort of project format in future courses.* [Emphases added.]

Graduate student stories rarely referenced the actions of people in power that influenced their PP scores, but those that did focused on the same aspects of empowerment attributable to flexibility and assessment design as the undergraduate students above. Faculty members also did not reference people in power as often as undergraduate students did, but stories that did explicitly reference people in power discussed either their appreciation of the College's support during the transition, or of the efforts of themselves or their colleagues to empower students during class. For example, one faculty member discussed hearing about empowering assessment design from a colleague and expressed an interest in trying it:

Example story from a faculty member, PP 80, Extremely Positive

So much more than a final

I only teach in the fall semester and so I've been paying close attention to what my colleagues are doing this spring, just in case classes are still online, or blended, in the fall. Last week one of my undergraduate research assistants told me about a professor who changed their final exam to a final project. This professor gave their students three options to choose from: i) take a [technical topic area] and write a report on it; ii) write a critique of the first chapter of an unpublished [technical topic area] textbook; or iii) solve a [technical topic area] problem using different set-ups (in MATLAB). *The student I spoke to said they really liked this change to the normal final because it gave them a choice about whether to dig into the conceptual, practical, or coding sides of vibrations, as well as a chance to create something new, not just solve problems.* I really love this idea and I'm thinking about how I could incorporate it into my class. [Emphases added.]

Another faculty member expressed incredulity in how well the College was able to transition to online learning in such a short timeframe, owing largely to the efforts of colleagues and clear guidance from administration:

Example story from a faculty member, PP 99, Extremely Positive

We achieved the impossible

We had been working for more than two weeks to transition our college to fully online instruction. I can't even begin to tell you how difficult this task seemed to me when I first realized that we would have just two weeks to convert every lecture and every lab class for the rest of the semester from the way we had been teaching for my entire career to fully online instruction. *I had so many doubts on that first day, but the Dean and the School Chairs came up with a set of check points and I began working with my colleagues to make it happen.* That two weeks of preparation time went by in an instant. I don't think I have ever worked so hard, learn to use new online tools for recording lectures and holding meetings online. It was intense but we kept going because we knew that in a matter of days, we would be reopening the university for fully online instruction. *The day we would resume classes came and I was so worried*

> *that we would not be ready. But we were ready, and everything seemed to go just as we had worked so hard in preparing it to be.* [...] I am awestruck by what my colleagues and I have accomplished in just a few short weeks. We have achieved what I would have characterized as impossible if it weren't for the fact that we had no other options but to succeed. I am proud and deeply moved by what we have accomplished so that we may continue to the best of our abilities to serve our students! [Emphases added.]

Examining these stories revealed that, while both students and faculty felt the stress and crunch of teaching and learning during the pandemic, faculty were more empowered to make meaningful choices about what that teaching and learning environment looked like than students. Accordingly, when faculty leveraged that empowerment to provide meaningful choice and opportunities for input to students as well, student perceptions of how people in power behaved—and the emotional tones of stories they told—improved noticeably.

PIVOTAL VARIABLE: PUTTING OTHERS FIRST

The final pivotal variable concerned the notion of putting others' needs before one's own. Specifically, participants were asked to locate their story in response to the prompt "In this story I (or the person in my story) decided...", along a continuum from "To put myself first - my interests are most important" to "To put others first - my own interests aren't important." We refer to this dyad as the "Put Others First" dyad, or POF for short. High POF stories were more likely to be positive and provided by faculty, while low POF stories were more likely to be negative and provided by students. Figure 8 shows these correlations visually—while the spread of data is higher than the "People in Power" dyad above, negative responses are nonetheless clustered at low POF values, while positive responses are clustered at high POF values.

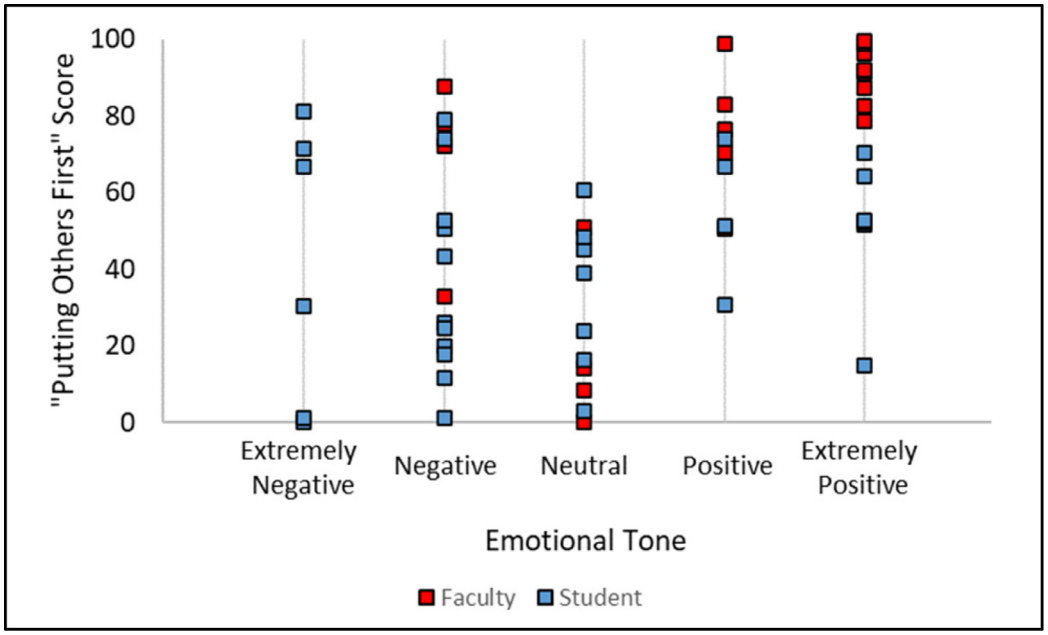

Figure 8 Relationship between Putting Others First (POF) score and emotional tone rating.

Like the Opportunity vs. Struggle pivotal variable above, positive faculty stories with high POF scores described instances of going out of their way to help students. In the following story, we read about a faculty member who created an alternative way for one of their students to pass their class.

Example story from a faculty member, POF 92/100, Extremely positive

> **An opportunity to 'rescue' a student**
>
> I had a student in one of my courses this spring who had missed a number of classes and certain key assignments. But when they were in attendance and turning

> assignments in, they were doing fine with those. I suspected that the student was either just blowing off the course or something was wrong in their personal life that was interfering. As we were approaching the drop date deadline (after we had switched to online), I noted that she was participating and doing fairly well. [...] The student reached out to me for advice, literally hours before the drop deadline. She said that there had been some particular difficulties in her life (even before the switching to online). *I sensed an opportunity to help make things right and gave her the list of in-class exercises and other assignments that she had missed.* I said I could not give full credit if she submitted those within a reasonable amount of time, but would be willing to give 80% maximum (otherwise would not be fair to other students). To this student's credit, within 2-3 days she submitted everything and [...] ended up with about an 84% overall score for the course, and earned a 'B'. *It made me proud to feel that I was able to help 'rescue' this student for this course.* The email exchange we had at the end of the semester was great as I got to say congrats! [Emphases added.]

Student stories with lower "put others first" scores often expressed challenges of transitioning to online learning, as illustrated in the following story. We gleaned from such stories that these students did not have the bandwidth to "put others first" because they were focused on managing their own emotions and keeping themselves afloat.

Example story from an undergraduate student, Put others first 1/100, Negative

> **Feeling OFF when I'm ONline**
>
> Engineering has always been challenging for me; however, I've always seen it as a puzzle; something that pushes my mind to think differently but excites me at the same time. I think I enjoy it so much because I'm able to work through problems at my own pace; I have a definitive start and end to my day. *However, with online learning, I've found myself not enjoying my classes as much.* Zoom classes seem to be too impersonal to me, messages about assignments are left unread via text and email, and even phone calls get lost in translation. As a result, I've found myself taking longer to complete assignments and lost a lot of the motivation I had before COVID-19. *Without peers to work with and professors to guide me in person, I'm finding online education very distant and frustrating.* [Emphases added.]

These excerpts reiterate findings from the other three pivotal variables—namely, that the empowerment to create successful teaching and learning environments helped faculty put others first, while students largely had to fend for themselves to succeed. One trend that was unique to this pivotal variable, though, is that several students rated their negative stories as having high POF scores. In these stories, students expressed empathy for others, for example the challenges that faculty faced in the transition to online learning, their peers, or people in more challenging circumstances abroad. In contrast to high POF faculty stories, these high POF student stories were negative more often than positive, perhaps because students had little control over others' experiences and were still left to worry about their own situations. We illustrate this pattern with the following excerpt from an undergraduate student's story.

Example story from an undergraduate student, POF 81/100, Extremely negative

> **Ill prepared**
>
> My transition to online classes is both one of understanding and annoyance. *My understanding comes from knowing that all of the professors are being forced to take on an online approach* despite not planning for the type of teaching and technical know-how that requires. My annoyance is that due to this lack of being equipped to handle a sudden and abrupt transition, some of my current professors have shown a marked decrease in actually teaching, or don't teach at all anymore. They instead opt to simply give out assignments, and give a due date. This degree of self teaching isn't the reason I pay for higher education. Beyond that, *the course load has actually increased in difficulty due to these shortcomings.* [Emphases added.]

DISCUSSION

We identified four pivotal variables from the Thriving framework used to design our data collection instrument that had quantitatively significant relationships with the emotional tone of student and faculty experiences in the University of Georgia's College of Engineering during the transition to online learning at the start of the COVID-19 pandemic. These variables also helped explain differences between faculty and student experiences. Qualitatively analyzing the stories participants chose to tell about their experiences during this time revealed further details regarding the nature of these relationships and differences. First, faculty had significant *opportunities* to redesign their courses for online learning in a way that they believed supported their students, while students typically had little choice but to *struggle* to figure out how to thrive in online learning environments on their own. Second, and following the same trend, faculty were able to leverage the pandemic as a means of *experimenting* with their teaching and learning environments, while most students described having little capacity to do much else than survive in a new and more difficult learning environment. Third, these trends were perpetuated by structures in the College of Engineering's transition to online learning in which *people in power* offered ample support to help faculty transition successfully, but ultimately disempowered students from engaging in decision-making processes—except where instructors explicitly presented opportunities to empower students in their learning and assessment. Fourth, faculty largely perceived themselves as *putting others first* in their instructional decisions, while students believed they needed to fend for themselves in the new online learning environment, even when they expressed empathy for others worse off than themselves.

The common theme running throughout this qualitative analysis is the primacy of *empowerment* and *ability* in determining how well one is able to thrive in times of crisis and sudden change. In our results, we found that faculty, by and large, felt *empowered* to take control of the situation in redesigning their courses to adapt to the swift transition to online learning, and were further able to exercise professional judgment as issues arose throughout the rest of the semester. This empowerment manifested in a variety of ways, including treating students with compassion as they struggled with the transition and being willing to experiment with new instructional approaches and assessment methods better suited for the online learning environment. They further expressed that the two weeks of preparation time with no classes in the middle of the semester ensured they were *able* to execute the remainder of their courses successfully. Faculty participants viewed the transition to online learning as achievable and within their control, and they were able to thrive as a result.

Conversely, we found that students, by and large, perceived themselves as *disempowered* by instructional and policy-related decisions that were made without their input. Even in cases where students may have had room to experiment and exercise control, many found themselves *unable* to focus on anything other than survival in an environment that featured more difficult coursework, necessitated new methods of learning, and was further complicated by pandemic-related personal issues. Under these conditions, students seemed to be unable to thrive for reasons they perceived to be beyond their control or means to overcome.

While the focus of this study is on our Spring 2020 data, we also note that results from Fall 2020 using a similar data collection instrument strongly reinforced our findings in this study related to empowerment and ability. As opposed to Spring, where instructors were encouraged to experiment with course design and find solutions to the transition to online learning, the University System of Georgia decreed that all courses in the Fall would use a hybrid synchronous teaching model, and faculty did not have the option to teach in any other format. As a result, many faculty cited the *disempowerment* to experiment with their teaching methods as a source of discontent, and we quantitatively found that faculty stories' emotional tone, on average, dropped to be on par with students' ongoing negative experiences (Engineering Education Transformations Institute, 2020e).

These observations combine to highlight the impact of *capacity building* to a system's ability to adapt to crises and subsequent, sudden changes of instructional needs. Recalling our definition of capacity building from earlier, it refers to efforts that increase the *ability and empowerment*

of system actors to adapt to changing instructional needs and collectively achieve shared instructional objectives (Bain et al., 2011; Baser & Morgan, 2008; Brinkerhoff & Morgan, 2010; Stoll, 2009). These two dimensions of capacity – ability and empowerment during the transition to online learning – were the major themes we found to be related to faculty and student experiences during Spring 2020 in UGA's College of Engineering.

Prior to the pandemic, EETI used the majority of its educational development programming to focus on building capacity among College of Engineering faculty, building communities of faculty that could support one another instructionally and connecting faculty with new ideas and resources to advance instruction. Following from these capacity building efforts, we observed that faculty were active in consulting one another as they successfully redesigned their courses for online learning, and rarely hesitated to reach out to EETI to get help in solving problems and building new skills. Unfortunately, the capacity we had built in faculty did not translate to capacity in our college's students, except where faculty specifically created opportunities for student empowerment. This undesirable finding suggests two important features of capacity that must be addressed to ensure high quality student experiences in times of rapid change.

First, capacity was apparently *localized* to groups of actors, such that building capacity in one group of actors does not necessarily increase the capacity of groups elsewhere in the system. In our case, our extensive efforts to build capacity among engineering education faculty paid off with positive faculty experiences during the transition to online learning, but our decision to focus on faculty consequently led to low capacity in students to handle the transition well. This insight reveals an important caveat to the foundational adage in engineering education that faculty are key levers for institutional change (e.g., Jamieson & Lohmann, 2012; The National Academy of Engineering, 2005) – while this statement is true, engaging faculty as the *only* levers for change can lead to an educational system where students are not sufficiently empowered or able to productively work toward the institution's goals for high quality teaching and learning.

Second, capacity could be fostered in one group by another, but doing so required intentional effort. In our data, we saw this in action when instructors acted to empower students to have control over how they learned or were assessed. Accordingly, one potential faculty development solution to the localized nature of capacity is to explicitly develop capacity in faculty to develop capacity in their students—to develop *metacapacity* in faculty, one might say. In doing so, faculty developers could help build institutional cultures where faculty empower and enable students to take control of their own learning in ways not common to more traditional classroom structures in STEM. To our knowledge, this concept of "metacapacity" as the capacity to further build capacity at the organizational level is all but unexplored in institutional change and educational research alike.

For examples of ways to build metacapacity in faculty to empower and enable students to reach teaching and learning objectives, faculty developers can draw from a wealth of extant research and strategies related to student motivation and metacognition. For *empowerment*, models of motivation such as the MUSIC® Model of Motivation and Self-Determination Theory highlight providing meaningful control over learning and assessment processes as an important component of motivating students to engage with learning activities, and provide examples of strategies to empower students (Deci & Ryan, 2000; Jones, 2009, 2018; Reeve & Jang, 2006). Jones (2009, 2018) suggests multiple ways of providing this control, such as offering multiple ways of demonstrating knowledge (tests, projects, presentations, etc.); providing feedback that allows students to develop as individuals rather than fit a mold; incorporating multiple opportunities for students to provide feedback on (and thus shape) course policies; and being responsive to students' expressed needs. The primary goal of these strategies is to create student perception that learning is not something that just happens to them in a course, but rather that they are important agents in shaping their learning experiences.

For *ability*, research on metacognition frames effective learning as a skill in and of itself, and provides several strategies faculty can use to help students develop this skill (Ambrose, Bridges, DiPietro, Lovett, & Norman, 2010; Cunningham, Matusovich, Hunter, & McCord, 2015; Flavell,

1979; Williams, Cunningham, Morelock, & Matusovich, 2016). Cunningham (2023) outlines four component skills of metacognition that instructors can help students develop: (1) Planning how to approach a learning task; (2) monitoring the success of the approach; (3) controlling one's success by altering the approach as necessary; and (4) evaluating the approach post hoc to identify areas of improvement. Instructional strategies that address these skills include exam wrappers to aid post hoc evaluation (Cunningham, 2023; Cunningham et al., 2015) and tools to identify new study strategies like the GAMES survey (Svinicki, 2004). In retrospect, given the findings of this study, EETI would have retooled its programming during the early days of the pandemic to help faculty build capacity to empower students through motivation-inspired strategies and help students build metacognitive skills to enable them to reevaluate and restructure their learning practices during the COVID-19 pandemic.

CONCLUSION

The sudden national transition to online learning during the COVID-19 pandemic revealed a great deal about the capacity for change in teaching and learning at higher education institutions. Through this mixed methods study, we demonstrated that the University of Georgia's College of Engineering had high capacity in terms of faculty experiencing a positive and empowered transition to online teaching. Given the substantial work EETI has devoted to building instructional capacity among faculty in the College since 2017, we posit this work contributed to faculty thriving during the pandemic. However, we also observed that this capacity did not extend to students, who reported being overwhelmed and disempowered during the transition, except where their instructors explicitly made efforts to accommodate and empower their students. In response to this study, we caution that educational development targeting engineering faculty may not be sufficient to ensure transfer of benefits to students, and we propose the novel approach of metacapacity building as a means of enabling instructors to engage their students as reflective and empowered partners in the learning process.

APPENDIX: NUMERICAL VERSION OF TABLE 2

Table 2: How participants felt about their experiences on a five-point Likert scale from Extremely Negative to Extremely Positive.

	UNDERGRADUATE	GRADUATE	FACULTY	STAFF
Extremely Positive	5	3	9	1
Positive	4	–	6	1
Neutral	4	5	4	–
Negative	13	3	4	1
Extremely Negative	5	3	–	–

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COMPETING INTERESTS

The authors have no competing interests to declare.

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