A Rapid and Formative Response by the Engineering Education Faculty to Support the Engineering Faculty and Students Throughout the Extreme Classroom Changes Resulting from the COVID-19 Pandemic

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Introduction

The planning and consideration for complex issues and change within higher education are bureaucratic and prescribed, and for some, it may be a difficult process to endure, while others may take joy in the process. However, I do not believe that it would ever be considered an experience that could be taken for granted or even be a luxury. That is until that process was fast-tracked due to the necessity of the pandemic state of the world. This work aims to explore the role that a community of scholars played in the transition from face-to-face instruction to remote online learning in the wake of the global COVID-19 pandemic. A subset of questions were examined to define the perceptions of faculty at Texas A&M University (TAMU) related to pedagogical discussions amongst themselves and feelings of support by their academic community at the university. Interviews were conducted with members of an influential faculty group in the College of Engineering at TAMU concerning their experiences with that faculty group and the pandemic. The results from the survey were analyzed quantitatively and the interviews were explored qualitatively to understand the baseline experiences of faculty at our institution and the impact that a faculty group, like the one described in this work, had on faculty experiences during the COVID-19 pandemic.

In March of 2020, most universities, including TAMU, recognized the severity of the COVID-19 global pandemic and transitioned 20 million students and 1.5 million faculty from business-as-usual in-person standard protocol to a completely remote online environment. Within the span of 2 weeks, the largest concerted effort of change in the history of higher education in the United States was underway. This transition was all-encompassing, from classroom instruction, administrative meetings, research efforts, and beyond. No longer could the millions of people working and learning in these higher education institutions function as they had for decades. Even the effort of this change was relegated to a remote online format, with many faculty having minimal exposure to the tools necessary to be successful when beginning their journey towards transition. Bates, a leader in the field of online learning and distance education, penned an online article stating the difference between online learning and rapid forced transition to remote online courses, pointing out online learning is carefully planned out, while the rapid response required by many faculty

during this pandemic makes it a challenging task for transitioning existing courses [1]. Thankfully, the tools necessary to facilitate this change existed in the form of relatively accessible video conferencing services made available by technology companies such as Zoom and Cisco partnered with universities pre-pandemic.

The task of training instructors to use these tools in their classrooms was at the forefront of many educational specialists' minds. The main goal was ensuring that instructors would feel confident in their abilities to continue their classes remotely online. However, these specialists were vastly outnumbered by the sheer volume of faculty in need of assistance. This urgent and desperate need led many faculty to reach out to their peers. Over 700 engineering educators at TAMU raced to transition their courses to a remote online compatible format. In response to this event, there was a mobilization by a group of educators, known as the Engineering Education Faculty Group (EEFG), to begin addressing their colleagues' rapidly changing needs.

This group existed pre-pandemic as a community of practice that was formed with the intention of exploring engineering education as a group and provide resources and support amongst its members. However, The members of EEFG assumed roles as leaders in the transition to remote online learning. Leadership in this faculty group acted swiftly when the news was announced by the university administration that all work and classes would be transitioning to remote online formats. Two surveys were developed by this group to accumulate data that could better inform both themselves and their colleagues what challenges they may face in this new environment they were entering. The first survey and second survey were distributed in March and May of 2020, respectively, with total respondents of 3381 and 1506, respectively [2]. The results from these surveys were quickly aggregated and disseminated through various means and media to the entire college of engineering faculty. Recommendations to alter course structures and teaching methods were made to faculty following accepted best practices with this aggregated data in mind. This survey captured both faculty and student responses, although faculty responses were not used at the beginning of the pandemic as most efforts were placed on helping students. A total of 113 faculty responded to this survey, and those responses are discussed here.

The Engineering Education Faculty Group (EEFG) began meeting weekly during the pandemic to support each other. During these meetings, the members of the EEFG would share various methods that they were using in their own online classes and the struggles or successes that they were experiencing. Online education specialists would often attend and contribute to discussions during these meetings and act as an accessible resource for questions faculty might have as they navigated their online classrooms. This schedule of meeting weekly has continued throughout the pandemic and has continued to provide an outlet for various interactions between faculty and, on some occasions, special guests to speak at regarding various topics centered around engineering education practice and research. As of now, there is a strong community that has grown and has been excited to attend these weekly meetings to spend time with their fellow faculty and share their experiences over their weeks. Four of the EEFG members were interviewed, one of which is an online education specialist with TAMU and has been a staple member of EEFG during the pandemic. Grounded theory, defined by Corbin and Strauss, and Glaser, was used to analyze these interviews [3, 4]. Some of the interviewee's sentiments will be shared as a cross section of the impact that this community has had on its members.

Hammond et al. [5] analyzed the second survey mentioned above using grounded theory and a

multiple regression analysis. In that work, a regression analysis looked at various respondent perceptions of the transition to online learning. Engineering faculty in particular were found to have a generally more positive attitude related to the transition from face-to-face instruction to remote online learning formats compared to non-engineering faculty, while engineering student responses were more negative to the transition compared to non-engineering students. Hammond et al. [6] describes the creation and organizational structure associated with the EFFG for a more nuanced understanding of the EEFG and thier goals and mission as an entity at Texas A&M University.

Literature Review

Remote learning during the COVID-19 pandemic required that most faculty adjust their pedagogical practices and begin using new teaching tools. Johnson et al. surveyed 897 faculty and administrators across the U.S. with respondents from 47 states and 672 institutions and attempted to characterize the experiences felt by U.S faculty and administration during those early weeks of the pandemic [7]. Nearly all institutions had transitioned to remote learning, and many faculty voiced a need for support in order to stay resilient in the face of the new challenges introduced. Over half of these respondents came from large institutions with over 20,000 enrollments (36%) and medium institutions with between 5,000 and 19,999 enrollments (37%); additionally, respondents came from mostly four-year public institutions (47%) and four-year private institutions (37%). When transitioning their classes to a purely online format, 56% of respondents had to adopt new methods with this statistic increasing to 64% if they had never taught online before. A vast majority had to change their curriculum, with 93% reporting making at least one modification; for example, 64% changed the kinds of assignments or exams given, 48% decreased the amount of work necessary, and 32% lowered their expectations on the quality of work. Many faculty reported a desire for assistance with respect to the information on how to support remote students (64%), support faculty working from home (57%), and training materials for faculty on how to move courses online (54%).

Bates, a leader in the field of online learning and distance education, recommends developing faculty development programs for digital learning in order to enable faculty to be effective in the remote teaching environment [1]. Additionally, Bates emphasizes the importance of developing a digital learning strategy so that faculty can effectively work together toward common priorities and having the correct resources available to support digital learning.

Quezada et al. also recommend the preparation of an Instructional Plan of Action (IPA) and Instructional Response Plan (IRP) to support faculty in making significant and sudden transitions [8]. As a result of these plans, the Department of Learning and Teaching at the University of San Diego experienced a highly successful transition to remote learning. One of the strategies leveraged included establishing a regular channel of communication between faculty and teacher candidates for feedback on how best to deliver remote content and provide personal and professional support [8].

In addition to implementing the necessary adjustments to enable online learning, many institutions sought to establish social support tools for the faculty. A survey by Croll et al. of the NYULH Department of Neurology faculty and housestaff had respondents reporting increased levels of fear and anxiety caused by the pandemic in addition to other challenges introduced by the pandemic [9]. However, over 90% of respondents agreed that the counseling services and emotional support

efforts, e.g., virtual forums, meetings, and other forms of social interaction, being provided by the department were helpful. These support resources have aided the faculty and housestaff in being resilient [9]. Buckley also supports the importance of social connection in her description of the outcomes of establishing a virtual faculty development program to address problems caused by COVID (e.g., new course formats, student stress). This cohort contained four faculty staff groups from different regions who had not met for several years. Participants found the connection valuable, feeling empowered to face new challenges during the pandemic [10].

Lipscomb and Tate developed a program by the name "Fast Track to Teaching Online" at the University of Arkansas at Little Rock where an effort was made to "engage faculty to think intentionally about expanding their online teaching practice beyond initial COVID-based remote delivery to fundamental research-based course design and delivery quality standards" [11]. In their effort, a course was developed to work on improving the quality of online course offerings dubbed "STaR Online Course Design Quality Assurance Standards" to aid faculty in their goals to best serve their students at UA Little Rock. Trevisian et al. conducted a study to derive the constructs from an international survey across ten countries, the specific focus of the Higher Education Technology Survey was on faculty perceptions of and adjustment to teaching at a distance [12]. Trevisian et al. used an Exploratory factor analysis (EFA) method and found that faculty perceptions were more closely correlated with whether or not those faculty had used distance teaching before, whether or not those faculty had recent training in distance teaching and the extent that faculty had kept up with technologies related to distance teaching [12]. Trevisian et al. also found that perceived support from faculty is independent of prior experience and training for these respondents, and they suggest that distance learning training become a part of the basic training integrated into all teacher education programs [12].

While it is clear that essentially all faculty members in the United States underwent the process of transitioning their courses to remote online formats, the process of how various faculty reached that point is less developed and reported. By understanding the role faculty interactions between one another in settings like the Engineering Education Faculty Group played in the development of faculties' skills and pedagogy in remote online learning has yet to be fully explored. We hope that this work brings some understanding and these findings will inspire other groups to form at institutions around the United States that extend beyond this pandemic era.

Methods

The methods of data collection performed here were a survey developed by Hammond et al. that was made available via email to members of the collective university and interviews conducted with members of the EEFG [2]. A total of 113 faculty responded to this survey from an array of Colleges and departments at TAMU. See Table 1 for the academic positions and Table 2 for the colleges of participants in the survey.

Table 1: Academic Position of Participants in Survey [2].

Current Faculty Position	Count
Academic professional track faculty (Lecturer, Professor of Instruction or Practice, any rank)	31
Tenure-track faculty (Assistant Professor)	10
Tenured faculty (Associate Professor, Full Professor)	20
Staff with teaching privileges	2
Other	2
Unknown	48

Table 2: Academic College of Participants in Survey [2].

College	Count
Agriculture and Life Sciences	3
Education and Human Development	2
Engineering	23
Mays Business School	12
Nursing	1
Other	2
Unknown	70

The subset of survey questions chosen for analysis can be found in Table 3.

Table 3: Subset of Survey Questions [2].

Question	Subset of Survey Questions
Q1	How often did you discuss pedagogy with your colleagues before spring break?
Q2	How often have you discussed pedagogy with your colleagues after spring break?
Q3	How often did you discuss work flow ideas with your colleagues before spring break?
Q4	How often have you discussed work flow ideas with your colleagues after spring break?
Q5	How often are you engaging with these faculty communities?
Q6	Do you feel that you have a safe place in which to express your concerns?
Q7	Do you feel supported by your department and college during this sudden change to online classes?

Particular interest was given to examine the differences between engineering faculty respondents compared to the rest of the university.

Table 4: Interview Questions

Order	Question
1	How engaged were you in the past with faculty development groups like the EEFG?
2	How did interacting with the EEFG impact your teaching during the pandemic?
3	Did attending the Covid-19 presentation, where Preliminary survey results were discussed, impact your approach to teaching online during those first few weeks of the pandemic?
4	What techniques did you find most useful with your teaching during the early weeks of the pandemic, and throughout our time in this predominately online world? (Were any of those things that were discussed with EEFG members or within your own department groups?)
5	Did you feel that you were included in the discussions with the EEFG members, and that you were able to give as much advice and guidance as you received?
6	Did you bring the techniques you learned at the EEFG meetings to your department meetings and colleagues? If so, did your colleagues seem receptive of this information, or did they have their own advice to give to you to share with the EEFG?
7	What are some of the biggest takeaways from your experience with the EEFG related to the pandemic era we are living in now?
8	How have these techniques/interventions work with your students? Did you get any student feedback (positive or negative) and did it inform your future teaching?
9	Do you think you will continue to participate in a group like EEFG post pandemic?
10	If there is anything that I didn't ask that you would like to tell me about your experience with the Engineering Education Faculty Group please share that with me.

Interviews were conducted with four faculty members of the Engineering EEFG. These interviews consisted of 10 questions which can be found in Table 4. Interviews were conducted via Zoom where audio was recorded, and an automatic live transcript was taken through the Zoom interface. Those live transcripts were saved and compared to the audio recordings, where mistakes with the automatic live transcriptions were corrected manually. Interviews were loaded into NVivo as raw video files, and transcript files where they were coded and analyzed. The qualitative coding began by separating the responses from each interviewee by the individual questions asked during the interview, coding those responses, and then cross checking the codes for each question with other questions looking for common themes. Grounded theory was the basis of the qualitative coding, where codes were generated fluidly and organically and then consolidated into relevant overarching themes [3, 4].

Results

The responses of engineering faculty and non-engineering faculty to the subset of survey questions one week after the transition were examined to quantify any differences between those populations.The percentage of participant responses is given below in Tables 5 and 6. Most of the participants in the survey seemed to have frequent discussions about pedagogy with their colleagues before the online transition. It was expected that all faculty members, regardless of their

position (academic, professional track, tenure track, tenured, staff) and college (engineering, non-engineering), experienced a consistent decrease in opportunities to discuss pedagogy with their colleagues soon after the rapid transition to remote online learning. However, the Chi-Square tests suggest that the frequency of pedagogy discussion among colleagues did not change a week after this transition (χ^2 (6, N = 130) = 11.69, p > .05). It was also found that engineering faculty (χ^2 (6, N = 46) = 2.81, p > .05) and non-engineering faculty (χ^2 (6, N = 61) = 8.89, p > .05) did not experience a statistically significant difference in frequency of pedagogy discussion one week after the transition to online learning.

Additionally, it was expected that all faculty members, regardless of their position and college, experienced a consistent decrease in opportunities to discuss workflow ideas with colleagues soon after the transition. However, the Chi-Square tests suggested that the frequency of workflow idea discussions among colleagues did not differ statistically significantly after the transition, (χ^2 (6, N = 111) = 9.06, p > .05). It was also found that engineering faculty(χ^2 (6, N = 46) = 5.14, p > .05) and non-engineering faculty (χ^2 (6, N = 59) = 5.53, p > .05) did not experience a statistically significant difference in workflow discussion after the transition.

It was found that most faculty members were engaged in faculty communities regardless of engineering or non-engineering status (χ^2 (6, N = 44) = 8.20, p > .05). Among the participants, most of the faculty members felt that they had a safe place to express their concerns, with no statistically significant difference found between engineering and non-engineering faculty, (χ^2 (4, N = 42) = 2.87, p > .05).

Faculty's perceived support by their college and departments was also found to not differ statistically significantly between the engineering and non-engineering faculty with Chi-Square values of (χ^2 (4, N = 41) = 2.94, p > .05).

Table 5: Survey Responses

Response	Q1	Q2	Q3	Q4	Q5
Very frequently	3.08%	20.00%	4.69%	8.51%	12.50%
Frequently	21.54%	26.15%	12.50%	17.02%	26.56%
Somewhat frequently	33.85%	23.08%	21.88%	21.28%	25.00%
Neither frequently nor infrequently	13.85%	10.77%	17.19%	25.53%	12.50%
Somewhat infrequently	18.46%	10.77%	7.81%	14.89%	4.69%
infrequently	7.69%	6.15%	25.00%	10.64%	4.69%
Very infrequently	1.54%	3.08%	10.94%	2.13%	14.06%

Table 6: Survey Responses

Response	Q6	Q7
Definitely yes	53.19%	59.38%
Somewhat yes	14.89%	25.00%
Neither yes or no	17.02%	4.69%
Somewhat no	6.38%	7.81%
Definitely no	8.51%	3.13%

Table 7: Interview Thematic Breakdown

Theme	Frequency
EEFG organization and professional development	28
Training for remote online teaching	26
Improving teaching	25
Feeling of community	19
Student support	13
Increasing student engagement	12
Previous participation in faculty development	6

Through grounded theory qualitative analysis methods, seven themes were found from the interviews that were conducted. Those themes can be seen in Table 7. The most dominant three grounded themes are EEFG organization and professional development, training for remote online teaching, and improving teaching. Within the most dominant theme, there was a sub-theme where interviewees discussed their experiences of a feeling of openness in the EEFG regarding their exchange of ideas, their own personal teaching challenges, teaching commentary, and open dialogue pertaining to current events in both education and the general public. One interviewee shared their experience with the open and supportive nature of the EEFG

> *"... you can find new ways of engagement, you can refine your own strategies that you have in your head, and make them better, and it becomes a good place to discuss, openly, potential failure you may have had without any judgement. When somebody actually helps you diagnose the failure point that again refines the strategy for the future and makes it better, or if the success that at least you're sharing what worked pretty well with everybody else."*

The second theme of training for remote online teaching centers around interviewees' various experiences with either aiding in the training of other faculty for remote online teaching or training they participated in through the EEFG. Topics mentioned include informal Zoom training, remote online specific course design, active learning strategies and techniques, workshops for online teaching, and course social media discussion. Interviewees comments on this type of training were positive, a few quotes being:

> *"... it [EEFG] enhances some online skills that we clearly need to have going forward in our roles."*

> *"...I think keeping it simple, is definitely the way to think about it that's why I always tell people that the way to design any course especially online courses that that one thing idea right, what are the one or two things you want to see them take away and just build everything around it."*

The theme of improving teaching shared some common topics from the training theme, but the focus shifted from tools and techniques to pedagogical concepts and theory. Interviewees were vocal about student engagement in class and finding ways to achieve that in as many ways as possible through various means. Student engagement from their experience during the pandemic had been slipping, and traditional techniques for in-person courses were becoming less effective.

One interviewee recalls from their course feedback that

> *"...things were just horrible, students didn't think they could possibly learn in this world, but by the time we're rolling into November, they really are kind of seeing how things operate and understanding that its actually kind of nice for them..."*

Discussion

The Hammond et al. [2] survey was designed with the purpose of informing the university about the trials and tribulations students and faculty were experiencing. Original expectations were that the transition from in-person working teaching and learning to remote online environments would cause many of the survey questions related to pre- and post-transition perceptions and practices of faculty to trend negatively. However, there seems to be no statistically significant result across the set of eight questions that were examined in this work regarding pre- and post-transition differences. The lack of statistical significance in the difference between pre- and post-transition suggests that the faculty were not hindered by the pandemic in the early weeks when it came to working with their colleagues. They continued with what they were doing professionally and did not allow these extenuating circumstances to majorly alter these particular sections of their lives. There was also no significant difference between the engineering and non-engineering respondents for the examined survey questions, suggesting that while engineering faculty may go through some unique situations, overall, the experiences of faculty at TAMU relating particularly to the trying times of the COVID-19 pandemic transcended any differences that might have been prevalent otherwise. It is important to note, however, that the responses of this survey were taken at a very early point in the transition from in-person to remote online learning, and faculty may not have had the opportunity to fully immerse themselves in the world they would come to live in for the next year or so. There is also the fact that non-engineering disciplines such as education and business have had large and developed efforts to build courses with remote online pedagogy implemented long before the pandemic settled in. The preparation and struggle to bring courses online for those non-engineering faculty may have been less than reformatting curriculum that was not intended for remote online learning and was never expected to need to transition. Although, in the work by Hammond et al. [5] in the second survey that was delivered, and not examined here, engineering faculty were found to have more positive attitudes towards the transition to remote online learning compared to non-engineering faculty, however, those attitudes may not directly relate the the behaviors of faculty related to the frequency of interacting with colleagues.

The sentiment across the board from all interviewees is that the EEFG has benefited their lives either professionally as a teacher, as an academic, personally, and any combination thereof. While the sample size of interviews is admittedly small, all of those interviewed agreed in Question 9 of the interview in Table 4 that they would continue to participate in a group like the EEFG post-pandemic. That coupled with the statements made about the utility found in a community-based approach to sharing pedagogical knowledge and teaching techniques to support each other in their professional teaching goals and student outcome goals for their courses are positive impacts for the College of Engineering and the current and future education of students at TAMU.

Limitations

There are several limitations regarding this research. This survey was conducted only weeks after the transition from in-person to remote online learning took place. The rapid nature of this effort by Hammond et al. [2] to assess the needs of students and faculty has a downfall of possibly not allowing faculty the time necessary to fully adapt to the new world that they were operating in. This downside might be rectified by future work focusing on the impact COVID-19 has had on faculty over a year after the initial transition to remote online learning. The sample size of faculty responses is relatively small compared to the actual population of faculty at TAMU, where approximately 3,500 faculty are employed, and the sample size of the engineering faculty at a confirmed 23 participants is vastly smaller than the approximate 700 engineering faculty employed in the College of Engineering at TAMU. There is also the consideration of the small sample size of interviews, where only four individuals were interviewed, where a preferable sample of around 30 would be ideal, although the time constraints available to this research not being a fully-funded grant impacted the available resources to explore interviewing such a large sample size. While we didn't see statistically significant differences in the data that we did gather, we would hope that with larger sample sizes that we could definitely confirm that to be the case in future surveys that are pertaining to these ongoing issues in higher education related to the pandemic, but that is also contingent on funding and available resources for those involved in this effort.

Additional surveys should be considered to examine the long-term effects of primarily remote online learning as the dominant form of education over more than a year. University data aggregation would be ideal for exploring the various effects on education at TAMU, such as Q-drops during the Spring 2020 semester, retention and matriculation data of students, and choices of remote courses over face-to-face courses during the subsequent semesters of the pandemic.

Conclusion

The COVID-19 pandemic has taken a toll on everyone in the United States, many have lost friends and family to the virus, and even today, we cannot see an end to the pandemic-centric world we live in. Despite the circumstances dealt with, it seems that our faculty at TAMU are carrying on as best they can. Even as we write this an author's student lost a family member to COVID this weekend. Faculty continue to put their best effort in to adapt to this remote online world in higher education and continue to work on supporting their students and colleagues every day. The EEFG is an example of dedicated faculty that took these pandemic circumstances in stride. They made it their mission to bring TAMU up with them in their efforts to continue to provide the highest quality of education to their students and training needed for their members and colleagues to achieve that in this remote online environment. As we move forward during this pandemic, we can only hope that one day we will return to a *"normal world."* Although some of the innovations and efforts to engage students in remote online education might continue to carry over and possibly benefit future students as faculty embrace progressive pedagogy, the community that was formed as a result of the meetings the EEFG has continued to hold weekly meetings that perpetuate a positive and innovative attitude towards teaching driven with support from leadership in the group and support from within its ranks.

Acknowledgements

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