Perspectives from Engineering Faculty on Teaching Expectations in a Post-COVID World

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Introduction

The coronavirus (COVID-19) pandemic has required faculty to rapidly adapt to online teaching, a modality that was rare in engineering education prior to the pandemic. In March 2020, a national emergency was declared in the US (Vaterlaus et al., 2021), and essentially all higher education institutions shifted to an online teaching model. With this rapid shift, it is important to study how faculty experienced the unprecedented challenge of the transition and understand their teaching expectations of teaching modality for the Fall 2021 semester following a year of online teaching. This study employed a qualitative approach leveraging focus groups and represents 28 engineering faculty's reflections on their teaching experience and expectations at a midsize northwestern US university. The data was collected during the late Spring 2021 semester when the Fall 2021 semester was expected to return to live, full capacity instruction. Themes identified through the data analysis are discussed in context of better understanding engineering faculty teaching expectations.

Although the institution offered a traditional college experience during the Fall 2020 semester, faculty had a choice to continue with online teaching. Health precautions on campus had been changed to prevent the spread of COVID-19 in the classroom and included policies such as mask wearing, social distancing, adjusted classroom capacity, and blended learning. A majority of faculty in this study chose to teach online in the Fall 2020 semester and the online learning was either in asynchronous or synchronous format. The following questions were explored:

1) What have you learned teaching during COVID-19 that will influence your teaching in the future?
2) What are expectations for teaching in the fall 2021 semester with the current state of COVID-19?

Methods

Qualitative approach and research paradigm

This study employed a focus group approach with the discussion group aimed at better understanding how faculty thought about their experiences and developed their expectations of teaching during the pandemic time (Krueger & Casey, 2014). Focus groups were an appropriate approach because open-ended questions "allow participants to select the manner in which they respond", and "focus groups encourage interaction among respondents and allow people to change their opinions after discussions with others" (Krueger, 1998, pp.6). This approach allowed the researchers to focus on producing concentrated amounts of data on precisely the areas of interest - teaching perspectives during the academic year 2020/2021 and what faculty expected for teaching in the Fall semester 2021/2022. Discussions were conducted in an unstructured way where respondents were free to provide any perspectives. At the conclusion of each focus group, the moderator asked participants to verify the moderator's summary comments.

Context

In the Fall semester 2020, universities and colleges in the US varied in their approaches and some reopened with online, in-person, hybrid or mixed instructional methods (Vaterlaus et al., 2021). Similar to many other higher education institutions, the institution involved in this project allowed faculty to decide whether to employ blended/synchronous, or asynchronous, or in-person instruction in both Fall and Spring semesters 2020/2021. During this period, the pandemic affected the US severely and COVID vaccination was just rolling out in the US in December 2020. Faculty at this institution used Webex, a software available for teaching online in non-engineering courses prior to the pandemic, and none of faculty in this study used to teach virtually before. Some engineering faculty instructed in-class in the academic year 2020/2021, while others conducted blended/synchronous instruction only in the Spring semester.

Data collection methods, instruments, and technologies

Five focus groups were conducted in April 2021; each group ranged 2-10 members, and included mixed female and male faculty, tenure and non-tenured faculty. Each focus group interview via Zoom lasted approximately average 50 minutes. Interview transcripts were de-identified and stored in encrypted files on secure servers. Among the twenty-eight faculty, 20 were tenure-track and eight non-tenure track faculty, with 14 female and 14 male faculty participating - representing over 21% faculty of the College of Engineering. Faculty represented five departments including civil engineering computer science, electrical engineering, mechanical and industrial engineering, and chemical and biology engineering.

Units of study

The moderator introduced unstructured focus groups to the study questions to foster interactions on the topics studied. Although focus group analysis asserted that the group is the fundamental unit of analysis, Morgan (1999) argued that the discussion in focus groups depends on both the individuals that make up the group and the dynamics of the group as a whole (Morgan, 1999) . Individual faculty have academic freedom to decide how to teach their course and there are mixed tenure and non-tenured faculty in each group discussion. Tenure-

track faculty's workload include teaching, research, and service, while non-tenured faculty are mainly responsible for teaching.

Data processing

Interviews were transcribed verbatim in NVivo software (version 20). The code structure was initially two topics of the inquiry, integrated approach inductively and deductively to search for common thoughts and differences between faculty and within group. The research team independently immersed themselves and identified words and phrases that matched with the research goals, then agreed upon data coding.

Data analysis

The focus group approach was used to understand diverse experiences, opinions, and expectations of faculty's teaching experiences during the academic year 2020/2021 and their expectations for the Fall 2021 semester. For example, the focus groups were asked: What have you learned teaching during COVID-19 that will influence your teaching in the future? And, what are expectations for teaching in the fall 2021 semester with the current state of COVID-19? Also, the focus groups were asked questions "What do you think is realistic from a student standpoint to have the instructor do to help them still progress in the class?", "What do you do if somebody misses class?", "What would be the best recommendation that you could get from the institution to help you in the fall?", or "What do you think would be a good kind of message from the administration for the fall?".

Results

Four themes emerged that represented engineering faculty's perspectives: faculty's adaptability to online-teaching and to accommodate students; flexibility versus academic freedom; expected live instruction for the Fall 2021; and, opportunity for potential graduate recruitment.

Faculty's adaptability to online-teaching and to accommodate students

Most faculty learned new skills to adapt with the transition to online-teaching such as creating videos, recording lectures, managing breakout-rooms on Zoom/Webex since many had little experienced with remote teaching. Furthermore, for synchronous classes, faculty were flexible to manage the class in both Zoom/Webex and in-class at the same time, while they were traditionally responsible for a single mode of the instruction. In terms of pedagogy, flipped classroom was implemented during this unprecedented period, though active learning was mainly applied among faculty. Students were required to watch videos and took quizzes before coming to the class. Furthermore, with the online breakout rooms, faculty found more balanced interaction with students rather than in-class as they could "see" all students at once on Zoom/Webex.

Student learning behaviors varied in terms of attendance and engagement. Due to the COVID-related reasons, faculty had to post lectures and class recordings in a learning management system for students, so students could access to their courses' learning materials instead of coming to a synchronous mode. After the Spring semester 2020 when the pandemic suddenly outbroke, faculty were better experienced in the Fall 2020 semester to manage classroom and engage with students as students reported "happy with the online sessions and better in-person faculty – student interactions" in a synchronous class. Moreover, grading empathy was another emerged faculty's adaptability during the pandemic. Some faculty experimented with different components of grading such as weekly quizzes or accumulated classwork practices to engage students.

Flexibility versus academic freedom

"*I think my largest fear is that there's going to be an expectation that everything is as accommodating as this last year*", a faculty expressed.

There were contrary opinions about student participation in blended classes. The majority of faculty across five focus groups agreed student participation decreased significantly when students had flexibility to learn blended/synchronous model versus in-person session. For example, a faculty experienced only five out of 40 students attended in the Spring 2021-in-class course, while another faculty saw good attendance for the first few weeks, then "three students at the end of the semester". On the other side, computer science faculty witnessed the increase of student participation in their online class.

Faculty indicated that, with their teaching experienced in 2020, they expected to have teaching freedom in the Fall 2021 semester to require student attendance. Faculty also expressed desire to be able to see the class and determine how to teach and interact with students. Two department heads conveyed they let faculty decide what would be the best for their class, to be flexible, and did not expect faculty to "two parallel courses" (i.e. synchronous mode). Faculty also expected to have teaching assistants for supporting students and in case the class-size would require blended instruction.

Expected live instruction for Fall 2021

"*I absolutely want to be live*" – a faculty stated

Twenty five out of 28 faculty expected to teach live in the Fall 2021 semester, while two planned for online and one for blended approach. Faculty appreciated student interactions in person because students' feedback showed "*the students really need the instructor and the interaction with the instructor*" and "*a lot of nonverbal communication getting missed via Zoom*". Also, faculty expected a small number of students attended virtually to minimize extra workload.

Faculty have learned and gained some best practices that they expected to carry forward for the Fall 2021 semester such as producing 4–5-minute recap videos, setting up live/scheduled time recap interactive session, using virtual assignment folder for students (e.g. Dropbox) rather than hard-copy assignment collection. The recap video of what was learned each week helped to engage students to conveniently review instead of watching all pre-recorded lectures. Moreover, flipped-classroom pedagogy would continue to be applied as faculty are able to post online materials ahead of the class that require students to prepare either for the in-person class or a blended model.

At the time of focus-group interviews, most of faculty had not yet been vaccinated, so they expected to be flexible to accommodate students depending on student health conditions such as quarantine if needed. If an in-class mode would be implemented, students were expected to come to the class, and online materials such as lecture recording, lecture notes, summary notes should be supportive for students with excused absences only. In terms of learning assessment, faculty expected to have normal midterm and final exams, rather than weekly quizzes or "take home exams" that were implemented for two semesters in 2020. Furthermore, faculty were

willing to extend office hours, provide debriefs, and "giving face to face feedback" to support students.

Opportunity for potential graduate recruitment

There are only two institutions offering graduate-level Computer Science degrees, and only one PhD degree in Computer Science is granted at this institution in the state-level context. A lot of graduate students are working professionals. Since the pandemic occurred, work-from-home or online working and online learning have become a new normal living condition, so faculty suggested that restructuring the graduate-level program of computer science comprising of in-person and online components is opportunistic for potential graduate recruitment.

Discussion

The flipped classroom has been proven effective (Bredow et al., 2021) and applying flipped learning approach in engineering education is "a relatively new field of research but exponential growth" (Al Mamun et al., 2021). Faculty in the present study were flexible to apply the flipped classroom to accommodate the teaching situation and student learning behaviors. Faculty served as second-line responders to not only help encourage students as academic role models, but also help students persevere through the pandemic (Neuwirth et al., 2020).

Representing faculty from different departments of engineering in this study have also illustrated the diverse teaching experiences during the pandemic, so providing engineering faculty instructional timely support to adjust engineering instructional approach is necessary. The interim report of American Society for Engineering Education (2020) indicated the long-lasting problem in engineering education was the lack of training in online teaching skills, while faculty have reported to redesign the course, lab activities, and at the same time, learning new tools and skills in such a sudden manner (American Society for Engineering Education, 2020). However, engineering faculty have illustrated their adaptability to transit to different modalities with student-centered learning outcomes and their empathy to student's well-being as students experienced the learning disruptions caused by the pandemic (Bigman & Mitchell, 2020). Simultaneously, there was uniform frustration with the lack of time to adequately prepare to switch modalities during the pandemic. Additionally, supporting multiple modalities to accommodate all student needs was uniformly seen as unsustainable.

Student engagement in the transition of online teaching was lower due to COVID-19 (Walker & Koralesky, 2021). Faculty in this study found the synchronous classes were time-consuming extra efforts to manage the class both in-person and online. Thus, they expected to have extra help from teaching assistants to support and accommodate students, and to teach in-person to better faculty-student interactions as well as for the learning assessment and accreditation.

In case of this study, we note several limitations. First, the sample size was small and self-selected faculty within a higher education institution, not representing the full faculty voice in the engineering field. Second, the inquiries were explored in a unique situation of teaching and learning engineering courses during the pandemic that may shift the engineering education from now on in terms of course design and assessment, innovative course delivery, lab interactions, and faculty development support such as instructional technologies. Third, analysis of the data in this study provokes the questions, "how can engineering faculty be better supported to design courses that stimulate learning in such an abrupt interruption of traditional teaching?", "how have engineering students learned during the pandemic to enhance teaching

and curriculum innovation?". To address these questions, we propose institutional administration to acknowledge faculty concerns, facilitate diverse teaching approaches, and provide necessary support to adapt with the unknown challenges.

Conclusion

Engineering faculty have adapted well to the transition to various instructional experimentations during the pandemic as they acknowledged both challenges and self-learning opportunities. Difficulties of student engagement and accommodations were identified, so the in-class instruction was highly desired by faculty, especially with the COVID-vaccine discovery. Faculty uniformly agreed that simultaneously supporting all modalities of learning to accommodate COVID was unsustainable going forward and should not be an expectation. Although the study focused on engineering faculty's perception of teaching experiences and their expectations in a unique period of academic career, it illuminates opportunistic possibilities for recruitment, particularly for graduate-level computer science program. In closing, teaching and learning engineering disciplines have arrays of innovative demands to be discussed in a post-COVID world.

Declaration of competing interests

References

Al Mamun, M. A., Azad, M. A. K., Al Mamun, M. A., & Boyle, M. (2021). Review of Flipped Learning in Engineering Education: Scientific Mapping and Research Horizon. *Education and Information Technologies*. https://doi.org/10.1007/s10639-021-10630-z

American Society for Engineering Education. (2020). *COVID-19 & Engineering Education An Interim report on the community response to the pandemic and racial justice*. American Society for Engineering Education. https://ira.asee.org/wp-content/uploads/2020/10/COVID-19-Interim-Report-Final_Sept2020.pdf

Bigman, M., & Mitchell, J. C. (2020). Teaching Online in 2020: Experiments, Empathy, Discovery. *2020 IEEE Learning With MOOCS (LWMOOCS)*, 156–161. https://doi.org/10.1109/LWMOOCS50143.2020.9234318

Bredow, C. A., Roehling, P. V., Knorp, A. J., & Sweet, A. M. (2021). To Flip or Not to Flip? A Meta-Analysis of the Efficacy of Flipped Learning in Higher Education. *Review of Educational Research*. https://doi.org/10.3102/00346543211019122

Krueger, A. R. (1998). *Analyzing & Reporting Focus Group Results*. SAGE Publications, Inc. http://dx.doi.org/10.4135/9781483328157

Krueger, A. R., & Casey, A. M. (2014). *Focus groups: A Practical Guide for Applied Research* (5th ed.). SAGE Publications, Inc.

Morgan, D. L. (1999). In *Focus Groups As A Qualitative Method* (2nd ed.). Little Blue Book. https://dx.doi.org/10.4135/9781412984287.n2

Neuwirth, L. S., Jović, S., & Mukherji, B. R. (2020). Reimagining Higher Education during and Post-COVID-19: Challenges and Opportunities—Lorenz S Neuwirth, Svetlana Jović, B Runi Mukherji, 2021. *Journal of Adult and Continuing Education*, *27*(2), 141–156.

Vaterlaus, J. M., Shaffer, T., & Pulsipher, L. (2021). College Student Interpersonal and Institutional Relationships during the COVID-19 Pandemic: A Qualitative Exploratory Study. *The Social Science Journal*, *0*(0), 1–14. https://doi.org/10.1080/03623319.2021.1949553

Walker, K. A., & Koralesky, K. E. (2021). Student and Instructor Perceptions of Engagement after the Rapid Online Transition of Teaching due to COVID-19. *Natural Sciences Education*, *50*(1), e20038. https://doi.org/10.1002/nse2.20038