Presence, Participation, and Pedagogy: Revisiting Face-to-Face Learning in Engineering Programs (Work-in-Progress)

Dr. Cristina Diordieva, Arizona State University

Cristina Diordieva is currently a postdoctoral researcher at Arizona State University in the Ira A. Fulton School of Engineering at the Polytechnic School. She is a co-author of two reports published by the World Health Organization (WHO) in Switzerland. Her research focuses on inclusivity in STEM, educational technology, engineering education, and qualitative research methodologies.

Dr. Medha Dalal, Arizona State University

Dr. Medha Dalal is an assistant research professor and associate director of scholarly initiatives in the Fulton Schools of Engineering at Arizona State University. Her career as an engineering education researcher focuses on addressing complex engineering education challenges by building capacity for stakeholders at the grassroots, while also informing policy. Her research seeks to transform and democratize engineering education by exploring ways of thinking, identifying effective professional development approaches, and uncovering pedagogical techniques to enhance students' engineering curiosity, engagement, and learning.

Dr. Nadia N. Kellam, Arizona State University

Nadia Kellam (she/they) is Associate Professor of Engineering and the Associate Director for Research Excellence within The Polytechnic School of the Ira A. Fulton Schools of Engineering at Arizona State University. She is a faculty in the Engineering Education Systems and Design PhD program. Dr. Kellam is an engineering education researcher and a mechanical engineer. She is also deputy editor of the Journal of Engineering Education and co-chair of ASEE's Committee on Scholarly Publications. In her research, she is broadly interested in developing critical understandings of the culture of engineering education and, especially, the experiences of marginalized undergraduate engineering students and engineering educators.

Prof. Kurt Paterson P.E., Arizona State University

Kurt Paterson enjoys re-imagining higher education with others, then making it happen.

Presence, Participation, and Pedagogy: Revisiting Face-to-Face Learning in Engineering Programs (Work-in-Progress)

Introduction

Exploring students' and faculty members' views on the significance and role of face-to-face learning environments is important for adopting teaching methodologies to today's diverse educational needs. While the transition to online learning offered flexible and accessible methods of learning, it also generated concerns about decreased engagement, community feel and belonging that is naturally fostered in face-to-face learning environments [1]. A broad range of studies focuses on the benefits of face-to-face instruction, particularly in STEM education (see, for example, [1], [2]). Active learning in face-to-face situations significantly improves student performance in STEM subjects [2]. Similarly, some studies found that consistent attendance in face-to-face classrooms interacts constructively with higher exam scores and total course grades [3]. Specifically, direct interactions in face-to-face learning produce higher levels of engagement than online alternatives. Furthermore, personalizing a sense of belonging (SB) in face-to-face courses is an important factor impacting student retention and academic motivation [4]. This is especially essential for engineering students, who regularly rely on collaborative work as a necessary component of their education [5]. For underrepresented students, the transition to online learning poses significant challenges, especially in building communities for academic achievement. Due to the limited social interaction, marginalized students tend to be more susceptible to disengagement and isolation [2]. It is imperative to understand students' and faculty members' perspectives on learning and teaching in face-to-face contexts, as universities struggle to reintegrate students into face-to-face classes. This study aims to explore these perspectives to inform strategies that enhance face-to-face course effectiveness and ensure a supportive, inclusive learning environment in the post-pandemic era. To achieve these aims, this broader study addresses three research questions:

1. What factors influence students' decisions to enroll or not enroll in face-to-face courses, and how can these insights inform strategies to promote participation?
2. How do teaching practices, student interactions, and community-building manifest in different face-to-face classes within engineering programs?
3. According to students and faculty, how does face-to-face instruction shape academic engagement, community building, and educational practices?

In this WIP, we will focus our analysis on the 1st and 3rd research questions. These questions align with our preliminary data and offer a foundation for exploring enrollment decisions and the perceived value of face-to-face instruction in engineering education.

Methodology

This study focused on students and faculty from a polytechnic engineering program at a large southwestern U.S. engineering college. Undergraduate and graduate students were recruited (n=100) and 11 selected for interviews to capture diverse viewpoints from various academic years and courses. Additionally, faculty participants(n=20) were recruited and six were selected based on having taught at least one face-to-face course. A qualitative research approach was chosen to get a better understanding of complex social phenomena and educational practices [6] and to explore and understand the perspectives of both faculty and students regarding face-to-

face teaching and learning. Semi-structured interviews enabled flexibility in the specific questions addressed while participants shared their unique experiences and insights [7]. These interviews allowed us to analyze personal views and perceptions about face-to-face learning and teaching, offering a detailed understanding of how face-to-face instruction shapes academic engagement, community building, and educational practices. Faculty members were asked questions about teaching approaches, engagement strategies, and the challenges of face-to-face instruction. Meanwhile, students were asked about their face-to-face interactions, engagement with course content, and sense of community in the classroom. This combination of faculty and student perspectives helps to understand both the teaching and learning experience [8]. Thematic analysis was used to analyze the data from semi-structured interviews. Thematic analysis is commonly used in qualitative research to identify and interpret themes within the data [9]. First, the data from interview transcripts was transcribed and read several times to gain a better understanding [10]. After reading the transcripts several times, the emerging codes were identified by two coders who independently examined the data to guarantee credibility and dependability. Codes such as "engagement," "interaction," "feedback," and "community" were used to label responses [11] based on prior understanding and informed by the research questions. After initial coding, the codes were grouped into broader recurring themes. The findings for this WIP paper are based on the responses from 11 students and 6 faculty members. By the end of the academic year, we intend to collect and analyze more data to reach data saturation, ensuring that no new themes will emerge from the data as a critical objective in qualitative data analysis [12]. The primary focus of this study is on face-to-face instruction. While some findings include discussions from students and faculty regarding online instruction in contrast to face-to-face experiences, the authors have chosen not to analyze these aspects in depth for this WIP paper.

Preliminary Findings

Three preliminary themes emerged.

Theme 1: The Role of Interaction, Engagement, and Accountability. This theme addresses key factors that influence educational experiences from different points of view of students and faculty. The main codes used to identify the theme are as follows: real-time interaction, engagement, instructor presence and accountability.

Students' standpoint. Students equally appreciate the immediate feedback and depth of interactions provided by face-to-face learning, emphasizing its importance in fostering meaningful educational experiences. One student explained, "because by going there, seeing the professor there … I can always raise any of my doubts which come to my mind at that moment." Students also identified engagement as a key topic, recognizing that planned participation in face-to-face formats fosters the dedication and commitment required for effective learning. Many students believe that face-to-face environments offer a level of discipline and accountability that is difficult to achieve online. For students, accountability emerged as a primary factor impacting educational achievement, with many students expressing that the structure of face-to-face classes helps maintain their focus and productivity.

Faculty's standpoint. From the faculty's standpoint, the immediate availability of direct interactions in face-to-face settings enables real-time adaptability to students' needs, allowing instructors to adjust their teaching practices to address understanding gaps. Faculty members

recognize the importance of participation but acknowledge the challenges of fostering engagement across online formats. One faculty member noted that student engagement varies significantly, with some students thriving in online settings while others struggle due to a lack of direct interaction: “Students who start to struggle online fail more… they're too far in to then recover...” Another faculty member emphasized that if the course is well-structured, students can achieve the same outcomes, regardless of modality, but he did admit that face-to-face courses seem to have greater engagement rates.

Theme 2: Barriers and Facilitators to Course Enrollment. In this theme we discuss social, logistical, and financial factors that discourage students from enrolling in face-to-face classes, and factors such as financial incentives, accessibility, and instructor's engagement. The main codes used to identify the theme are as follows: financial constraints, logistical challenges, flexibility, and financial incentives.

Students' standpoint. Financial factors were found to be the main barrier to enrollment in face-to-face courses. Some students suggested that offering scholarships would greatly motivate attending face-to-face courses, especially for low-income students. Meanwhile, logistical constraints were commonly seen as a main struggle among students who lived off campus or commuted long distances daily: “It might be tough with the traffic and everything like that. So, I will prefer the online courses,” one of the students stated. Nevertheless, most of the students clearly prefer face-to-face classes because of the advantages of active participation and lively interactions with teachers and classmates: “I am able to be more focused and interact with my teachers, my professors, and my colleagues.” On the other hand, some students prefer the flexibility of online courses that balance their education, work, and family. Therefore, these results suggest the importance of offering diverse formats that accommodate varied students' needs.

Faculty's standpoint. Faculty similarly agreed and added that many students have substantial financial difficulties related to accommodation and transportation, validating that financial barriers are far beyond tuition alone. Other faculty emphasized the need to reduce costs and provide more scholarship opportunities for face-to-face students. Regarding offering more flexibility to face-to-face classes, faculty also discussed the importance of accommodating evening classes for students with daytime personal obligations: “We just try to do different times … accessible to our students.” These results suggest that addressing financial barriers through scholarships, lower tuition, and more flexible scheduling is critical for increasing face-to-face enrollment as well as understanding of students' different needs.

Theme 3: Teaching Practices and Classroom Dynamics. This theme discusses the role of instructional approaches and interactions that naturally occur in face-to-face environments. The main codes used to identify this theme are as follows: natural connection, instructional practices, and classroom dynamics.

Students' standpoint. Many students identify natural connections with face-to-face classrooms. One of the students explained how a strong sense of camaraderie was created by the basic routines of attending classes, commuting, and connecting with friends in person: “I was able to connect with other people in my group…we sat together, we shared our ideas, we wrote the

paper." At the same time, the instructor's enthusiasm and clarity are very important to the students: "… my learning ability highly depends on the capacity of the lecturer." Students also explained that obstacles like big class numbers might make participation difficult: "150 or 200 students. It's more like a conference rather than a lecture," emphasizing the need for smaller and more interactive groups.

Faculty's standpoint. Faculty members also expressed the natural connection that face-to-face interactions can promote. One faculty member stated: "There's someone there that you can kind of tap on the shoulder and say, hey, are you getting this?" This indicates how face-to-face interactions can promote immediate and personal connection. It is imperative to note that not all face-to-face settings naturally promote a feeling of community as it relies on a number of factors including the dynamics of the classroom and teaching methods. On the other hand, faculty acknowledged that they felt isolated and had difficulty interacting online and recognized the challenge of encouraging meaningful online engagement: "…whether that's built into an LMS like Canvas, that works, but no one likes doing that. It feels like work." Despite the use of platforms like Slack or Canvas chat, faculty explained that these tools lack bridging the social and emotional divide between learners and instructors, especially when it comes to fostering a feeling of community. Results suggest that thoughtful strategies are therefore needed in the online mode to mimic the sense of community that is more organic in face-to-face situations [13].

Conclusion, Implications, and Future Directions

The preliminary study findings have various implications for both academic practice and policy. Early findings confirm previous research on the significance of direct engagement and real-time feedback for effective learning [14] and emphasize the key role of face-to-face interaction in building a sense of community [4]. That said, this study offers new insights by identifying several financial and logistical barriers to enrollment, and the often overlooked meaning of classroom dynamics in building natural connections. For example, enrollment in face-to-face courses may be restricted due to financial constraints and logistical challenges, which emphasizes the importance of institutions adopting more flexible and inclusive policies [15]. This study contributes to the existing literature by presenting significant concepts that enhance the current discussion about educational approaches. One major conclusion is the recognition of accountability as a critical element in academic achievement. Students emphasized that the monitored setting of face-to-face courses promotes discipline and focus, which they believe is more difficult to attain in online formats. This advances our understanding of how accountability mechanisms could potentially be applied in online contexts to foster student engagement and learning outcomes. The future work for this study will delve deeper into an exploration of the face-to-face learning modality and a comparison of face-to-face and online teaching and learning, particularly focusing on student engagement, sense of community, and academic performance. This will lead to analyzing more data until saturation is reached, as well as discovering more robust and persistent themes. Finally, this study will add to the continuing discussion regarding the future of higher education and how to best integrate different teaching settings to optimize student engagement, success, and retention. As a result, the findings of this study will enable institutions to efficiently combine face-to-face and online learning experiences, balancing flexibility with community-building to match the evolving demands of various student backgrounds [16].

References:

[1] Dulfer, N., Gowing, A., & Mitchell, J. (2024). Building belonging in online classrooms: relationships at the core. *Teaching in Higher Education*, 1-17.

[2] Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, *111*(23), 8410-8415. https://doi.org/10.1073/pnas.1319030111

[3] Callister, R. R., & Love, M. S. (2016). A comparison of learning outcomes in skills-based courses: Online versus face-to-face formats. *Decision Sciences Journal of Innovative Education*, *14*(2), 243-256.

[4] Buckley, J. B., Robinson, B. S., Tretter, T. R., Biesecker, C., Hammond, A. N., & Thompson, A. K. (2023). Belonging as a gateway for learning: First-year engineering students' characterizations of factors that promote and detract from sense of belonging in a pandemic. *Journal of Engineering Education*, *112*(3), 816-839.

[5] Mercier, E., Goldstein, M. H., Baligar, P., & Rajarathinam, R. J. (2023). Collaborative learning in engineering education. In *International Handbook of Engineering Education Research*. 402-432. Routledge.

[6] Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, Quantitative, and Mixed Methods Approaches*. Sage publications.

[7] Brinkmann, S. (2014). Unstructured and semi-structured interviewing. *The Oxford Handbook of Qualitative Research*, *2*, 277-299.

[8] Maxwell, J. A. (2013). *Qualitative research design: An interactive approach*. 116–140. SAGE Publications. https://doi.org/ 10.4135/9781473983953.n6

[9] Clarke, V., & Braun, V. (2017). Thematic analysis. *The Journal of Positive Psychology*, *12*(3), 297-298.

[10] Saldaña, J. (2018). Researcher, analyze thyself. *The Qualitative Report, 23*(9), 2036–2046. https://doi.org/10.46743/2160-3715/2018.3685

[11] Charmaz, K. (2008). Grounded theory as an emergent method. *Handbook of Emergent Methods*, *155*, 172.

[12] Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field methods, 18*(1), 59-82.

[13] Shepherd, C. E., Bolliger, D. U., & McKim, C. (2024). Online University Students' Perceptions of Institution and Program Community and the Activities That Support Them. *Online Learning*, *28*(1), 216-240.

[14] Mandouit, L., & Hattie, J. (2023). Revisiting "The Power of Feedback" from the perspective of the learner. *Learning and Instruction*, *84*, 101718. https://doi.org/10.1016/j.learninstruc.2022.101718

[15] Ko, K., Bartoszuk, K., Peek, S. A., & Hurley, M. (2023). Profiles of First-Generation College Students: Social, Financial, Academic, and Cultural Barriers to College Lives. *Journal of College Student Retention: Research, Theory & Practice*. https://doi.org/10.1177/15210251231188508

[16] Alvarez Jr, A. V. (2020). Learning from the Problems and Challenges in Blended Learning: Basis for Faculty Development and Program Enhancement. *Asian Journal of Distance Education*, *15*(2), 112-132.