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Beyond "How's it going?": A Collaborative Autoethnographic Study by Early Instructors in a First-Year Engineering Studio Course

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Abstract

In this complete research paper, we study student-instructor communication in an engineering studio course. Studio pedagogy is an increasingly popular active learning technique. This tradition of pedagogy deemphasizes faculty lecture and emphasizes student-directed project work. However, studio pedagogy draws heavily on instructor-initiated communication for effective instruction. A limited body of research suggests that such communication is challenging, and we posit that early instructors experience additional, as-of-yet unidentified challenges. To better understand these communication issues, a team of four undergraduate course assistants and one faculty member conducted a collaborative autoethnographic study of instructors learning to teach in a first-year studio course. We identified the challenges the (student) instructors faced and the approaches they used. For instance, the instructors faced an *interaction barrier*—sources of resistance to initiating a student-instructor interaction, such as a lack of instructor self-confidence or student reticence. We illustrate challenges instructors faced and their approaches to resolve them through reflective episodes from the instructors. Our audience is twofold: Education researchers will find new lines of investigation for future work on studios, while early instructors will learn how to get started with teaching in studios.

Introduction

Studio instruction is a useful active learning alternative to passive approaches, such as pure lecture. Drawing on a tradition from architecture and the fine arts [1], studio instruction de-emphasizes the instructor and instead promotes student learning through engagement in difficult projects. Studio instruction has been used to achieve various instructional goals, such as promoting student employability [2], concept transfer [3], use of experimental tools [4], and generally improved learning outcomes, e.g., performance on the force concept inventory [5].

However, studio courses have unique challenges when compared with a traditional lecture-based approach. Studio pedagogy relies on a tradition of *desk critique*—spontaneous interaction between student and instructor in response to student work [1]. Hence, spontaneous and reactive student-instructor communication comprises more of an instructor's role, compared with lecture. Prior work on studio instruction suggests that this student-instructor communication is difficult: A study of architecture studio instruction found more communications gone awry than were successful [6]. While architecture and fine-arts studios have a reputation for harsh critique, some instructors have difficulty expressing negative judgments in desk crits—a necessary step to help students recognize their opportunities to improve and grow [7].

New faculty interested in studio instruction are faced with additional challenges, compared with those experienced in the approach. Engineering faculty who have experienced primarily lectures in their own training may not have examples to draw on for delivering desk critiques. This is compounded with a lack of faculty training in other areas, such as classroom management: Even in K-12 education, fewer than half of teacher preparation programs cover sufficient classroom management practices [8]. Such student-oriented communication skills are also important for promoting equity in the classroom: Dewsbury [9] suggests that student-faculty interactions may be the single greatest intervention available for addressing identity contingencies—helping students deal with issues such as stereotype threat.

Despite its importance, there is limited prior work on teachers developing these communication skills in a studio context. Research on studio instruction often focuses on student experience rather than instructor experience (e.g., [2], [10], [11]). Some of the prior work on instructors in studios comes from an architectural tradition, rather than studios in engineering disciplines: Rands *et al.* [12] identified instructional affordances in architectural studio pedagogy (formal and informal critique, "mini-lectures," and demonstrations). However, their sole instructor participant was an instructor with eight years of experience; their focus was less on the instructor's learning than on their developed expertise.

Therefore, we studied how early instructors in an engineering studio course learned to navigate student-instructor communication. Our motivations are both scholarly and pragmatic: Our aim with this work is to produce a manuscript that is useful to education researchers thinking about studio pedagogy, but also accessible to those interested in or just starting to teach using studio pedagogy in an engineering context.

Research questions

In the context of engineering studio courses,
RQ 1. What communication challenges do early studio instructors face?
RQ 2. What strategies do instructors use to overcome those challenges?

Methodology and Methods

This work was determined to be IRB exempt by Brandeis University's IRB,[1] following a human subjects protection protocol (#24037R-E). We used the *quality in qualitative research* (Q3) framework to promote research quality throughout data collection and analysis [13], [14].

Collaborative Autoethnography (CAE)

Autoethnography (AE) is derived from *auto*biography and *ethnography* [15]. The AE tradition uses study of the self as a means to understand others, seeking generalization not in a nomothetic sense, but rather in an idiographic tradition [13]: Results from AE are expected to

[1] As a small college, Olin works with Brandeis University to oversee human subjects research.

generalize in the sense that others in a context similar to that of the autoethnographer may have similar experiences. While ethnography uses observation of others as a means to understand culture, AE has the unique affordance of making innermost thoughts and sensitive issues visible [16]. This affordance is well-aligned with our RQ 1—to make visible the challenges early studio instructors face, as they experience and make sense of those challenges.

Increasingly, engineering education researchers are engaging in *collaborative* autoethnography (CAE) to investigate topics such as navigating the tensions inherent in STEAM [17], using technology in the public interest [18], and learning to do education research in an unsupportive environment [19]. CAE builds on the strengths of AE through team communication, where deeper understanding can result from collaboration among multiple investigators [16]. Given the idiographic nature of this work and its importance to constructing and interpreting results, we describe the research site and team next.

Research Team

The research team consisted of four senior undergraduate engineering students (Berwin, Bill, Esme, and Luke: henceforth “the instructors”) and one faculty member (Zach, the “faculty member”), all at Olin College. The instructors were hired as teaching assistants to the first-year, first semester class *Modeling and Simulation of the Physical World* (ModSim), taught by the faculty member. All four instructors had substantial previous experience as course assistants, and had taken many studio courses (by virtue of Olin’s curriculum), including ModSim.

Zach recruited and trained the instructors as a pilot of a teacher training program for course assistants. This training program included a three day “pedagogy bootcamp” on active learning, learning goals, assessment, and equity. Notably, the content on equity included Dewsbury’s [9] *deep teaching* model, which also entered into the analysis of this work. Zach pitched the idea of this research project to the student instructors. The instructors were enthusiastic about getting involved in research and potentially developing useful results for faculty development, and agreed to join the study.

Research Site and Course

Olin College is an undergraduate-only engineering college in Needham, MA (USA). Olin was founded with college-level goals that include a strong emphasis on student motivation, that students experience working on teams, and that students become self-directed learners [20]. Studio courses were incorporated early in the design of the college, and courses such as ModSim were designed to use studio affordances to support the aforementioned goals.

We introduce ModSim in terms of its high-level learning goals, followed by a description according to the four axes of Little and Cardenas [1]:

Learning Goals: ModSim serves several purposes within Olin’s curriculum: It is an introduction to important tools (computing with MATLAB), course-specific content (mathematical modeling practices), and college-level goals (self-directed learning). It is *not* a design class, but uses many of the ideas from architecture and design pedagogy.

Physical Space: The studio space for ModSim follows best-practices for design studios, featuring an abundance of open space and good lighting [1]. Figure 1 shows some of the physical features of the space, including large tables for groups of students with laptops and sidewall whiteboards for *ad hoc* instruction.

Figure 1. (*Left*) Typical table group in ModSim. (*Right*) Sidewall whiteboard.

Studio Exercises: The content of ModSim is organized into five highly-scaffolded worksheets, three self-directed projects, and a handful of hands-on activities [21]. The learning in the worksheets is more “directed,” in the sense that students do not choose what to work on and for which there are accepted ‘correct’ answers. Most worksheets take the form of MATLAB LiveScripts, which are structured as *literate programs* to serve as both reading and exercise [22]. The worksheets are designed to be completed over a week of instructional time and are intended to introduce the ideas necessary to complete project work, described next.

Pedagogy: As Little and Cardenas [1] write, “The pedagogy of the studio is based upon the idea that students will learn best those things they have taught themselves in response to difficult and challenging assignments.” ModSim is thus structured around three student-directed projects, each of which require students to develop their own scientific question, build and assess a mathematical model, and use the model to answer their question. The students’ first project is highly scaffolded, while the later projects introduce more student choice.

In a typical session of ModSim, students are assigned (randomly) to small table groups which serve as assigned seating. Students use their Olin-issued laptop to do worksheets or make progress on their project (depending on the calendar). Instructors (both faculty and student instructors) support student learning through an adaptation of *desk critique*.

Architectural studio pedagogy includes a tradition of desk critique—a spontaneous discussion between student and instructor about work in progress. ModSim adapts this tradition, as instructors circulate around the classroom and either decide to initiate an interaction with students, or are called over to answer student questions. The challenges navigating these interactions are at the heart of the research questions for this work.

Assessment: While not a strong focus of this work, ModSim assesses learning goals through project work artifacts and post-project written reflections.

For the Fall of 2023 (in which data for this project was collected), ModSim had an enrollment of 98 students, two faculty, and four student instructors. This resulted in sections of approximately 25 students each, supported by one faculty member and one student instructor, both of whom attended all class sessions. Since this is a first-year (first-semester) course, most students have very little familiarity with studio pedagogy—they were learning "how to do" a studio course in ModSim.

Methods

Our methods were informed by the *quality in qualitative research* (Q3) framework [13], [14], which led to proactive research design decisions to promote quality through data collection and analysis. We summarize our methods here.

The instructors conducted data collection and analysis on their classroom experiences over a 14 week semester. They each maintained a teaching journal and referenced a shared "methods document" for reflection questions. The reflection questions were written using the critical incident technique (CIT) to help reduce self-report bias [23]: The CIT involves focusing on a specific lived episode, rather than speaking of ideas in the abstract. The instructors conducted an initial autoethnographic analysis through writing their reflections, and shared these findings in weekly meetings. The full team (instructors and faculty member) met weekly to discuss episodes from each of the four instructors; the faculty member served as a facilitator in these discussions and took detailed notes. These notes served as the primary data source for the present report—these discussion notes reflect both the individually constructed meaning from instructor reflections, as well as the co-constructed meaning from collaborative discussion. The team also returned to the methods document to collaboratively revise the reflection prompts, so as to maintain resonance and relevance with the instructors' experiences, promoting communicative validation [13]. Changes to the reflection questions were documented in the methods document, serving as an "audit trail" [24] to promote process reliability [13].

While the instructors conducted individual and collaborative analysis through their reflections, the faculty member served as an "editor" to assemble the report. Zach conducted this work with an orientation towards prioritizing student voice (to promote communicative validation [13]), operationalized as presenting verbatim instructor quotes.

To assemble the report, the faculty member engaged in two cycles of coding [25]: The first cycle involved initial (topic) coding of the discussion notes [26]. Zach constructed codes from the point-of-view of the instructors; for instance, the code *having self-efficacy* refers to instructor self-efficacy. Here and throughout, codes appear in italics. In quotations, square brackets denote inserted text, with codes italicized and clarifications in plain text.

The second cycle involved analytic coding [26]: Zach sorted the initial codes into related groups, and constructed branch codes to organize these initial codes into "leaf" codes. Two primary groups helped organize the leaf codes: some codes described *challenges* that instructors experienced, while others described *approaches* the instructors used to address challenges. We describe the full coding tree further in the Results section.

Note that we did not impose an *a priori* theoretical framework; however, theoretical ideas did align with our findings at the second coding cycle. In particular, Dewsbury's [9] *deep teaching* model entered the project as part of the instructors' training and served as a *sensitizing concept* [27] for the last author when assembling the results. *Deep teaching* ultimately "earned" its way into the analysis as a set of "branch" codes to organize the instructor approaches.

Finally, Zach used the resulting code tree as an "analytic handle" [28] to navigate the data and assemble the report. There were many more episodes than could feasibly be discussed in a conference manuscript. For brevity, Zach filtered the codes and episodes through his own experience as a studio instructor and developed a final set of organizing themes that form the section headers of the Results.

At the outset of this project, the team established a mutually agreed upon set of rules for reviewing any reports of the reflection data. Our results are presented in non-anonymous form; therefore, all team members reviewed the Results section as an ongoing consent process. All team members reserved a "right to veto" the inclusion of any of their reflections in the manuscript, and actively engaged in reviewing both their own and other teammates' quotations for possible risks. This process draws on ideas of ethical validation—the empirical observation that actively seeking to do justice to all research stakeholders will tend to promote research quality [14]. In our case, engaging in the review for release process also gave each instructor a chance to add depth to their quotes (communicative validation) and engage deeply with the developing arguments of the work (pragmatic validation) [13].

Results and Discussion

As noted above, all codes were categorized as either a *challenge* or an *approach*. In this section we further describe the coding results and discuss specific episodes from the (student) instructors' experiences.

Categorizing codes as Challenges and Approaches

In this section we briefly describe the coding tree resulting from qualitative analysis. The coding tree enabled aggregate statements about the corpus, but primarily served as an intermediate "analytic handle" [28] to organize the sections to follow.

We identified 5 *challenge loci* as branch codes that organize the challenge leaf codes. These describe *where* instructors identified challenges, not *what* caused them. Figure 2 schematically depicts the five loci, which are described next.

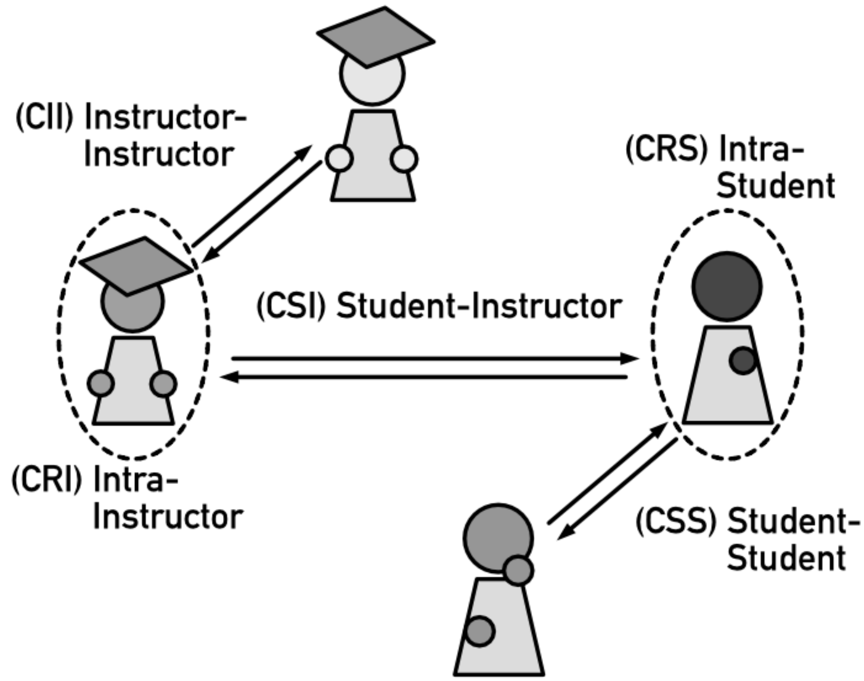

Figure 2. Challenge loci identified via interpretive coding: (CRI) intra-instructor, (CII) instructor-instructor, (CSI) student-instructor, (CSS) student-student, and (CRS) intra-student. Note that loci describe where challenges are *identified* with no claim about *causation*.

The five challenge loci:

(*CRI*) *Intra-instructor* challenges present from a single instructor.[2]
(*CII*) *Instructor-instructor* challenges present from an interaction between instructors.
(*CSI*) *Student-instructor* challenges present from an interaction between student and instructor.
(*CSS*) *Student-student* challenges present from an interaction between students.
(*CRS*) *Intra-student* challenges present from a single student.

Table 1 provides counts of all unique leaf codes for each challenge locus. *Intra-instructor* codes comprise 12 of 31 unique leaf codes, indicating that the student teachers had a notable inward focus in their discussions. *Student-instructor* codes also comprise a sizable fraction of unique codes, providing encouraging evidence that the reflection data can support investigation of our research questions. The relative paucity of *student-student* and *instructor-instructor* codes do not imply such loci are irrelevant to our research questions; instead, this indicates a lack of data coverage, and potential area for future work.

[2] NB. We use “instructor” to refer to all instructional team members: student instructors and faculty.

Table 1. Counts of unique leaf code for each challenge locus.

Challenge Locus	Unique Leaf Codes
(CRI) intra-instructor	12
(CRS) intra-student	9
(CSI) student-instructor	6
(CSS) student-student	3
(CII) instructor-instructor	1

The approach codes were found to be well-organized by the five competencies of Dewsbury's [9] deep teaching model:

(*ASA*) *Self-awareness*: The degree to which the instructor has an understanding of self, in the context of what they bring to the classroom.
(*AE*) *Empathy*: The degree to which the instructor commiserates with the social context of, and authentically listens to, students.
(*ACE*) *Classroom climate*: The general temperament created in a course, including factors such as physical layout, the nature of verbal interaction with students, and the structure of interactions between students.
(*AP*) *Pedagogy*: The approaches used to maximize (deep) learning and retention of course material.
(*ANL*) *Network leverage*: The use of campus support structures to facilitate student success.

The resonance of the *deep teaching* model with our results is somewhat unsurprising, as the instructors were introduced to Dewsbury's model in their initial training. Table 2 provides counts of all unique leaf codes for each approach competency.

Note that no codes related to *network leverage* were identified, indicating that the instructors did not discuss these approaches in our group meetings. However, upon reviewing a draft of this manuscript, the instructors noted that they *did* discuss *network leverage* elements with students, such as pointing them to campus resources like tutoring services. This illustrates a broader point for interpreting these results-—that the content of these discussions tended to focus on those learnings the instructors found surprising.

Table 2. Counts of unique leaf codes for each approach, organized by the five competencies of Dewsbury's deep teaching model [9].

Approach Competency	Unique Leaf Codes
(AP) pedagogy	36
(ACC) classroom climate	12
(ASA) self-awareness	7
(AE) empathy	4
(ANL) network leverage	0

In the following sections, we take a closer look at specific examples of challenges and the approaches the student teachers used to address them. As noted in the Methods section, these episodes were selected to illustrate broader themes in studio instruction.

Overcoming the interaction barrier

The ModSim studio is an environment where students engage in self-directed work. The instructors quickly recognized their responsibility to initiate interactions with students, but found a variety of challenges that served as a barrier to start such interactions. For instance, early in the semester Berwin noted,

> Berwin: "I wish I prodded them a little more. [*CRI: feeling unwilling to interrupt students*]"

This challenge clearly prevents effective student-instructor engagement; however, it emerges from a personal hesitation. This is an internal hurdle to be overcome, as Bill replied to Berwin, "You're not being weird by being direct." Later in the semester, Berwin recognized her own development,

> Berwin: "I'd walk up to tables and I wouldn't even be willing to ask 'how's it going?'. [*CRI: feeling unwilling to interrupt students*] Now I feel good asking questions. [*ASA: having self-efficacy*]"

In contrast with the passive environment of a lecture, a studio instructor is responsible for dynamically initiating interactions with students. This responsibility can be unfamiliar to new studio instructors, who must recognize their responsibility to initiate student-instructor interactions and develop the confidence to overcome internal barriers to interaction.

However, overcoming the interaction barrier also requires conversational skill. An obvious way to begin an interaction with a student (or group) is to walk close and ask "How's it going?" The instructors found this conversational start to be variable in effectiveness: The "How's it going?" prototype interaction with studio students proceeds like this,

> Instructor: (Arrives at table, upbeat) “How’s it going?”
> Hypothetical student: (Hesitant) “... good.”
> Instructor: “Great! Let me know if you have any questions.” (Leaves)

The instructors found the prototype interaction disappointing, as it does not address any instructional challenges. They found that nonverbal elements of communication, such as *AP: sitting with silence*, would promote more effective student-teacher interaction,

> Esme: “I realized I did the ‘Hey, how’s it going?’ thing. You have to lurk a bit before asking for it to work [*AP: sitting with silence*], and only the people who are medium confused will react.”
> Bill: “It’s like [the difference between] ‘How’s it going?’ as a question (which it’s bad at) versus ‘How’s it going?’ as an opening line.”

Silence—sufficient waiting—gives students enough time to formulate a question, and even then Esme found that only students who are “medium confused” will voice a concern: Students who are more thoroughly confused may find it difficult to articulate a confusion. The “opening line” Bill refers to is an entry point for approaches to reach these more confused students—to deploy other elements of pedagogy, such as *AP: probing students thoroughly* by *AP: asking questions*.

Luke found that other elements of nonverbal communication helped overcome the interaction barrier, such as a more open demeanor,

> Luke: “‘How’s it going?’ tends to feel like a ‘yes/no’ question to students. I find that saying ‘Hey, what’s up? Talk to me.’ gets students to describe more of what they’re doing.”

Not reflected in the discussion transcript is Luke’s body language: He tends to say “Hey, what’s up?” with a smile, and he will often crouch down at a table to put himself on the same physical level as a student. Luke found that this warm conversational approach helped overcome barriers to student-instructor interaction.

Navigating the physical and social space

The instructors adopted different approaches to navigating the physical studio space to observe different student groups. One such approach was *AP: doing rounds* (“*slow walk*”)—walking slowly around the studio to observe. In addition to information gathering, this approach made the instructors available for students to ask questions,

> Berwin: “I was doing my slow walk, [*AP: doing rounds (“slow walk”)*] and a student pulled me over to talk about the verification facts exercise.

The instructors had different approaches to doing rounds: Bill used a “fast walk” to quickly check on groups, then “sat out” to let students work independently. However, all the instructors treated *AP: doing rounds* as just one approach when *AP: switching between “modes,”* such as *AP:*

giving a mini-lecture. Mini-lectures are a common feature of studio pedagogy [1]; they are ad-hoc lectures often given in response to confusions observed in the classroom.

The instructors also discovered that they have the power to make changes to the physical configuration of the classroom, as Esme describes from a Jigsaw classroom activity [29],

> Esme: “I realized—oh, they just listen to me! For the Jigsaw discussion, I felt not confident coming in. [*CRI: instructor not confident*] … But the Jigsaw felt good by the end—I was overthinking it. As people were filtering in, I just said ‘go sit over there.’ [*ACC: reorganizing the classroom*] Ok, no one is thinking as much about the decisions I’m making as I am. [*ASA: de-centering self*]”

Here, Esme manipulated the physical space by directing late students to join Jigsaw groups. Beyond demonstrating the implementation of specific teaching techniques (e.g., a Jigsaw), this episode illustrates overcoming the *CRI: instructor not confident* challenge through *ASA: de-centering self*—focusing less on one’s own discomfort and more on the moment-to-moment elements of teaching. We will return to instructor self-efficacy in the next section.

The instructors also learned to navigate the social space of the classroom. Esme observed Zach helping a student learn to change the font size on their computer,

> Esme: “Zach asked, ‘Hey, can you actually read the text on your screen?’ [*ACC: using humor*] But it didn’t feel like you were judging them. [*ACC: being gently insistent*]”

Here, Zach employed *ACC: using humor* to overcome the interaction barrier. Esme generalized this use of humor to her own teaching practice,

> Esme: “There was a team talking about rocks and roads. [*CRS: student off-task*] I said, ‘Yeah yeah, the distribution of the rock sizes.’ I had to laugh at myself, because they were laughing. I was able to play off that. [*ACC: using humor*] … I was trying to be part of the non-content conversation. [*ACC: connecting to student interests*]”

Here, Esme recognized a *CRS: student off-task*—at least one student disengaged from the content of the course, and potentially distracting other students. However, rather than simply demand that students alter their conversation, she composed *ACC: using humor* with a student-centered orientation of *ACC: connecting to student interests*. This student-centered approach is oriented towards building a student-instructor relationship, which may help lower the interaction barrier.

Student-instructor relationships are dynamic entities that evolve over the arc of a course; hence, an instructor’s approach may also change on this timescale. Bill contrasted their experiences teaching in two different courses, and early in ModSim recognized this lack of a student-instructor relationship,

> Bill: "Before, (assisting a different class), I could just drop by a table and ask 'How's it going?' because I have rapport. [*ACC: drawing on student-instructor relationship*] A more 'casual,' less 'intrusive' check-in in ModSim does not have the intended effect. … I need to pause at the table more, with 'What are you working on?' [*AP: probing students thoroughly*]"

At this early stage of the class—within the first few weeks of ModSim—Bill found that they needed to use a more "intrusive" approach to overcome the interaction barrier and help support students' learning. However, as their previous experience suggests, Bill found that they could shift their approach as they developed a stronger student-instructor relationship.

Developing instructor self-awareness

Dewsbury's [9] deep teaching model positions instructor self-awareness as necessary for a pedagogy based on relationships. Dewsbury's notion of self-awareness goes beyond knowledge to incorporate personal history and disciplinary identity. In our study, the instructors found other elements of self-awareness that impacted their teaching practice.

As noted earlier, *ASA: having self-efficacy* helps instructors overcome the interaction barrier. However, just as with students, self-efficacy for instructors is not simply a switch to be flipped, but rather a resource to be developed. For instance, Bill initially found delivering mini-lectures difficult,

> Bill: "That was nerve wracking. [*CRI: instructor not confident*] But I talked to students later and they thought it was awesome. [*ASA: seeking feedback*] I used to think 'there can't be silence.' … I wasn't comfortable with silence or pauses. [*CRI: discomfort with silence*]"

Receiving positive feedback will clearly build an instructor's sense of self-efficacy. While discomfort initially prevented Bill from from using silence deliberately, with experience they found that silence can be used as a useful pedagogical approach,

> Bill: "I realized that having a pause is good: what seems like a break in your lecture is actually time for the students to think. When I became comfortable with silence after I asked a question, students gave more thoughtful answers. [*AP: sitting with silence*].

Bill described two elements that contributed to their development and maintenance of self-efficacy. First,

> Bill: "If you're looking for validation from students, then it's distracting to your students. [*CRI: instructor not confident*]"

Recognizing that one is looking for validation is an element of self-awareness stemming from self-efficacy: Bill found that they must look inward for affirmation, rather than expect this validation from students. Armed with this understanding, an instructor can begin to look outward to more fully engage in student-centered instruction.

Second, Bill described some specific steps to support their self-efficacy,

> Bill: “I’m not shouting, but I do have to hype myself up. [*ASA: hyping yourself up*]”

Bill actively maintains their self-efficacy by “hyping” themself up before teaching interactions. Such performance-derived approaches are not unheard of in teaching practice; for instance, Dewsbury [9] describes his own teaching approach, which includes regularly meeting with a Professor of Theater to develop his non-verbal cues.

Self-efficacy is not the only element of self-awareness. The instructors in this study were upper class students, close in age to their students. Luke articulated this challenge early in the course,

> Luke: “I thought I was going to relate to students differently. But it turns out it’s not that different; I have limited control over this. A few of the first years call me ‘ModSim Guy’. [*CSI: student rejects instructor’s self presentation*]”

Later in the course, Luke found a way to both accept and utilize students’ perceptions,

> Luke: “If this is who I am, what are the parts worth leaning into? By nature, I’m a goofy, not so serious person. I’ve tried being serious before, but that’s not who I am. … If I can lean into it, I hope students can lean into it too. Lean into your own quirks, don’t be afraid of judgment. [*ASA: tailoring self presentation for the classroom*]”

Luckily, Luke was comfortable embracing the “goofy” elements of his nature, which resolved his challenge. In his case, he was also able to leverage this self-awareness to encourage students to lean into their own identities. However, for other instructors with historically minoritized identities, such interpersonal challenges are far greater. These issues remain an important and open challenge in higher education.

Limitations and Conclusions

This work is an initial “portrait” of how early studio instructors navigate student-instructor communication. The challenges the instructors documented are necessarily incomplete: As noted earlier, the discussions among instructors seem to exhibit a “novelty bias,” as the instructors did not discuss elements of network leverage they deemed obvious. Furthermore, we studied these student instructors at a late point in their teaching journey; we did not collect longitudinal data that could illuminate the longer arc of their learning to teach. Extensive additional work would be necessary to fully explore the space of challenges and approaches in studio instruction.

However, the experiences described here illuminate some unique challenges new instructors face in engineering studio courses. The interaction barrier described above is a key hurdle for new studio instructors, requiring a combination of conversational skill and instructor self-efficacy to cross. Our study positioned instructor self-efficacy within Dewsbury's *deep teaching* model, a facet of self-awareness not discussed in that work [9]. It is likely that the interaction barrier has additional student-focused elements; our data cannot speak to these particularities, leaving such features as an interesting area for potential future work.

Note that our study focused on *new* studio instructors. It is unclear to what extent *experienced* instructors experience the interaction barrier described here. Our data collection also captured primarily verbal interactions; it is only through the reflective co-construction of our CAE approach that we captured a handful of nonverbal factors in student-instructor interaction. Future work using different methods, such as independent ethnographic observation or technologically-assisted approaches (e.g., instructor eye tracking) would provide a complementary view of student-instructor interactions.

A reviewer raised interesting questions about possible differences of interaction between students and (student) instructors, vs. interaction between students and faculty instructors. We agree that this is of interest, and note that the instructors did discuss this in our reflections. However, we believe that our present data are not sufficient to speak to that relevant social reality, as we did not record data from students *taking* the class—this "asymmetry" of our data collection would likely skew conclusions about such differences. Therefore, we note that such differences are an interesting avenue for future work, which may be explored with modified data collection protocols.

An important limitation rises from the background of the instructors: While our ambition is to support novice studio instructors, in reality all Olin students experience many studio courses throughout their training. Thus, all of our (student) instructors are not complete novices in studio pedagogy. It is likely that those with little to no experience in studio pedagogy may experience challenges not reported in our work. But it is our hope that this report provides those new to the studio an initial—though admittedly incomplete—view of how to navigate student-instructor communications. At the least, we hope to give you awareness of challenges such as the interaction barrier, and ideas for approaches beyond "How's it going?"

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References

[1] P. Little and M. Cardenas, "Use of 'Studio' Methods in the Introductory Engineering Design Curriculum," *J. Eng. Educ.*, vol. 90, no. 3, pp. 309–318, Jul. 2001, doi: 10.1002/j.2168-9830.2001.tb00610.x.

[2] F. Trede, R. Braun, and W. Brookes, “Engineering students’ expectations and perceptions of studio-based learning,” *Eur. J. Eng. Educ.*, vol. 0, no. 0, pp. 1–14, May 2020, doi: 10.1080/03043797.2020.1758630.
[3] E. B. Walker, D. M. Boyer, and L. C. Benson, “Using Studio Culture to Foster Epistemic Change in an Engineering Senior Design Course,” *IEEE Trans. Educ.*, vol. 62, no. 3, pp. 209–215, Aug. 2019, doi: 10.1109/TE.2019.2898151.
[4] F. Khan, N. Birchfield, and K. V. Singh, “Revitalizing the Engineering Curriculum Through Studio Based Instruction,” in *Volume 5: Education and Globalization; General Topics*, Houston, Texas, USA: American Society of Mechanical Engineers, Nov. 2012, pp. 131–138. doi: 10.1115/IMECE2012-89547.
[5] K. Cummings, J. Marx, R. Thornton, and D. Kuhl, “Evaluating innovation in studio physics,” *Am. J. Phys.*, vol. 67, no. S1, pp. S38–S44, Jul. 1999, doi: 10.1119/1.19078.
[6] C. Argyris, “Teaching and Learning in Design Settings,” in *Architecture Education Study*, vol. 1, W. L. Porter and M. Kilbridge, Eds., Cambridge, MA: MIT Laboratory of Architecture and Planning, 1978, pp. 551–660.
[7] S. Dinham, “Research on Instruction in the Architecture Studio: Theoretical Conceptualizations, Research Problems, and Examples,” presented at the Annual Meeting of the Mid-America College Art Association, 1987.
[8] NCTQ, “Classroom Management.” National Council on Teacher Quality, 2020. [Online]. Available: https://www.nctq.org/review/standard/Classroom-Management
[9] B. M. Dewsbury, “Deep teaching in a college STEM classroom,” *Cult. Stud. Sci. Educ.*, vol. 15, no. 1, pp. 169–191, Mar. 2020, doi: 10.1007/s11422-018-9891-z.
[10] A. Thompson, B. Sattler, and J. Turns, “Understanding a studio environment: A complex system approach to a community of practice,” in *2011 Frontiers in Education Conference (FIE)*, Rapid City, SD, USA: IEEE, Oct. 2011, pp. F3H-1-F3H-6. doi: 10.1109/FIE.2011.6142997.
[11] Z. del Rosario *et al.*, “Crafting a Virtual Studio: Some Models and Implementations,” in *ASEE National Conference Proceedings*, (Virtual): ASEE, Jul. 2021.
[12] M. L. Rands and A. M. Gansemer-Topf, “An Ethnographic Case Study of Affordances in an Architecture Design Studio,” *Teach. Coll. Rec. Voice Scholarsh. Educ.*, vol. 122, no. 8, pp. 1–48, Aug. 2020, doi: 10.1177/016146812012200809.
[13] J. Walther, N. W. Sochacka, and N. N. Kellam, “Quality in Interpretive Engineering Education Research: Reflections on an Example Study,” *J. Eng. Educ.*, vol. 102, no. 4, Art. no. 4, 2013, doi: 10.1002/jee.20029.
[14] N. W. Sochacka, J. Walther, and A. L. Pawley, “Ethical Validation: Reframing Research Ethics in Engineering Education Research To Improve Research Quality,” *J. Eng. Educ.*, vol. 107, no. 3, pp. 362–379, Jul. 2018, doi: 10.1002/jee.20222.
[15] C. Ellis, T. E. Adams, and A. P. Bochner, “Autoethnography: An Overview,” *Forum Qual. Sozialforschung Forum Qual. Soc. Res.*, vol. 12, no. 1, Art. no. 1, Nov. 2010, doi: 10.17169/fqs-12.1.1589.
[16] F. W. Ngunjiri, K.-A. Hernandez, and H. Chang, “Living Autoethnography: Connecting Life and Research,” *J. Res. Pract.*, vol. 6, no. 1, 2010.
[17] N. W. Sochacka, Kelly. W. Guyotte, and J. Walther, “Learning Together: A Collaborative Autoethnographic Exploration of STEAM (STEM + the Arts) Education,” *J. Eng. Educ.*, vol. 105, no. 1, pp. 15–42, Jan. 2016, doi: 10.1002/jee.20112.
[18] S. Chowdhary, S. Daitzman, R. Eisenbud, E. Pan, and E. Graeff, “Care and Liberation in Creating a Student-Led Public Interest Technology Clinic,” in *2020 IEEE International Symposium on Technology and Society (ISTAS)*, Tempe, AZ, USA: IEEE, Nov. 2020, pp. 164–175. doi: 10.1109/ISTAS50296.2020.9462188.
[19] J. S. Cicek, P. K. Sheridan, L. A. Kuley, and R. Paul, “Through ‘Collaborative Autoethnography’: Researchers Explore Their Role as Participants in Characterizing the

Identities of Engineering Education Graduate Students in Canada," presented at the 2017 ASEE Annual Conference & Exposition, Jun. 2017. Accessed: Aug. 18, 2020. [Online]. Available: https://peer.asee.org/through-collaborative-autoethnography-researchers-explore-their-role-as-participants-in-characterizing-the-identities-of-engineering-education-graduate-students-in-canada

[20] M. Somerville *et al.*, "The Olin Curriculum: Thinking Toward the Future," *IEEE Trans. Educ.*, vol. 48, no. 1, pp. 198–205, Feb. 2005, doi: 10.1109/TE.2004.842905.

[21] L. Raus, K. Mackowiak, S. Matsumoto, and Z. del Rosario, "The Meme Game: A Hands-On Activity to Introduce First-Year Engineers to Concepts in Mathematical/Computational Modeling," in *ASEE Annual Conference Proceedings*, Baltimore, MD: ASEE, 2023.

[22] D. Knuth, "knuth1984(TCJ)_literate_programming.pdf," *Comput. J.*, vol. 27, no. 2, pp. 91–111, 1984.

[23] J. C. Flanagan, "The Critical Incident Technique," *Psychol. Bull.*, vol. 51, no. 4, 1954.

[24] C. Faber, C. Bodnar, A. Strong, W. Lee, E. McCave, and C. Smith, "Narrating the Experiences of First-year Faculty in the Engineering Education Research Community: Developing a Qualitative, Collaborative Research Methodology," in *2016 ASEE Annual Conference & Exposition Proceedings*, New Orleans, Louisiana: ASEE Conferences, Jun. 2016, p. 25771. doi: 10.18260/p.25771.

[25] J. Saldaña, *The Coding Manual for Qualitative Researchers*, 2nd ed. Los Angeles: SAGE, 2013.

[26] L. Richards, *Handling qualitative data: a practical guide*, Fourth. Thousand Oaks: SAGE Publications Ltd, 2020.

[27] C. McCall and C. Edwards, "New Perspectives for Implementing Grounded Theory," *Stud. Eng. Educ.*, vol. 1, no. 2, p. 93, Feb. 2021, doi: 10.21061/see.49.

[28] K. Charmaz, *Constructing Grounded Theory*. 2014. Accessed: Jul. 20, 2022. [Online]. Available: https://public.ebookcentral.proquest.com/choice/publicfullrecord.aspx?p=5439903

[29] K. Tanner, L. S. Chatman, and D. Allen, "Approaches to Cell Biology Teaching: Cooperative Learning in the Science Classroom—Beyond Students Working in Groups," *Cell Biol. Educ.*, vol. 2, no. 1, pp. 1–5, Mar. 2003, doi: 10.1187/cbe.03-03-0010.