Examining How Engineering Educators Produce, Reproduce, or Challenge Meritocracy and Technocracy in Pedagogical Reasoning

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Examining how undergraduate engineering educators produce, reproduce, or challenge technocracy in pedagogical reasoning

Abstract

Sociologists and historians of science/engineering have documented the salience of meritocracy and technocracy in engineering and engineering education (Cech, 2014; Slaton, 2015; Riley, 2008). Some engineering education scholars have begun to document how technocracy and meritocracy have been mechanisms of marginalization within engineering education (Slaton, 2015; Foor, Walden, & Trytten, 2007; Secules, Gupta, Elby, & Turpen, 2018). Our team has been engaged in the iterative redesign of a pedagogy seminar for engineering peer educators working within a college-level introduction to engineering design course. Using tools of discourse analysis, we analyze how technocratic stances are reproduced or challenged in engineering peer educators' talk during pedagogy seminar discussions. We study peer educators, in particular, because they are in a unique position to do harm if the ideologies of meritocracy and technocracy aren't challenged. Likewise, they are in a unique position to do good if they actively disrupt these ideologies in the introductory engineering design course. We present empirical examples of engineering peer educators both reproducing and contesting technocratic (and, at times, meritocratic) stances in reasoning about engineering education. We believe that such empirical examples can help engineering educators hone their attention to student thinking in the classroom and help us understand what it might look like to see evidence of growth in students' reasoning.

Introduction

Cech (2014) and Slaton (2015) have documented meritocracy and technocracy as salient ideological pillars in engineering education. These ideologies are also evident in the engineering mindsets articulated by Riley (2008). Meritocracy and technocracy form structural conditions within engineering education that broadly contribute, over the course of students' engineering degree programs, to reducing engineering students' sense of social responsibility (Cech, 2014), which we see as harmful. In order to prepare students to pursue engineering for social justice, Leydens and Lucena (2017) call for engineering students to learn to identify these structural conditions, however, learning to "see" them is non-trivial since students more readily understand direct violence/harm than structural and cultural violence/harm (Lachney & Banks, 2017; Papak, Gupta & Turpen, 2018). Additionally, those from privileged backgrounds are more likely to struggle in recognizing the "culture of power" within disciplinary spaces (Delpit, 1988). So, we anticipate that it will be challenging work for engineering students to come to see the harm precipitated by these ideologies. However, little previous work has explored how and to what end these ideological narratives emerge in engineering students' reasoning (Lambrinidou & Caney, 2016; Lachney & Banks, 2017; Papak, Gupta & Turpen, 2018; Canney, 2018). Our paper contributes to this line of inquiry.

In this work, we study undergraduate peer educators who are taking a pedagogy seminar concurrently with serving as teaching assistants within an introductory, project-based engineering design course. Our data consist of audio-video records of class discussions and coursework in the pedagogy seminar. Using tools of discourse analysis, we operationalize how we "see" technocracy (and, at times, meritocracy) in peer educators' talk. We analyze two segments from classroom discussion. In one, we show how peer educators construct some teammates as inert and burdensome based on technocratic assessments of their contributions. In another, we show how having the opportunity to interact deeply with a student team in the design course allows some peer educators to take up stances that challenge technocracy.

Listening to engineering peer educators talk about pedagogy within particular classroom moments offers unique opportunities for seeing how they sometimes reproduce and sometimes challenge meritocratic and technocratic narratives in reasoning about engineering education and professional practice. The pedagogy seminar is not a "neutral" context; course readings and instructional activities aim to reveal how meritocracy and technocracy can be dehumanizing and to cultivate a sense of social responsibility for bringing (particularly marginalized) students into meaningful engineering work. In the long term, we aim to critically examine how these instructional supports influence peer educators' reasoning and instructional moves. In this paper, we explore how peer educators (re)produce or challenge technocratic stances in making sense of the design work of student engineering teams. This gives us the opportunity to investigate not only peer educators' reasoning but also the instructional conditions that may influence it. Understanding how these context-dependent reasoning dynamics play out in discourse can help us learn how to disrupt harmful ideologies and help peer educators generate alternatives.

We study peer educators, in particular, because they are in a unique position to do harm if the ideologies of meritocracy and technocracy are not challenged, and, likewise, to do good if they disrupt these ideologies in the engineering design course. Of the many actors who co-construct the culture of the design course, the peer educators are the ones closest to the students in terms of age, shared experiences, and day-to-day contact. Furthermore, as future practicing engineers, they will once again be in positions to influence the broader engineering culture. So, understanding how to cultivate critical stances towards technocracy and meritocracy within peer educators is worthwhile.

However, we also experience a certain amount of tension in our research focus on peer educators. While peer educators are in a position to create change in some ways, they are also vulnerable in other ways. The faculty instructors invariably have greater power within the course context to set the incentive structure (including grading), course policies, and classroom culture. Not all instructors would share a peer educator's desire to challenge technocracy and meritocracy. Furthermore, the faculty instructor occupies a higher position of institutionally-sanctioned power within the course, and negative reviews from faculty could impact peer educators' chances of getting rehired for this prestigious (and paid) position. Peer educators might also be a student in that faculty member's upper division course in future. As such, we feel a tension that perhaps the ethical action here would be to focus our reform efforts on faculty first. However, we also feel that we are in a weaker position to create change among engineering faculty, especially as many of our research team members are not affiliated with engineering. These ethical tensions are still unresolved for us and struggling with them is an ongoing part of our work.

Background: Technocracy and Its Impact in Engineering Education

Dr. Donna Riley, in her book, *Engineering and Social Justice* (2008), analyzes the prevalent jokes about engineers and engineering to document cultural narratives, or "mindsets," that characterize part of the broader culture of engineering and manifest themselves in the ways that engineering work is organized. Among the mindsets Riley outlines are: (1) Positivist epistemology / Myth of Objectivity, (2) Commitment to Problem Solving / Reductionism, and (3) Narrow Technical Focus / Lack of Other Skills. Thus, engineering is seen as mainly concerned with technical knowledge (as opposed to teamwork and collaboration), combined with epistemological orientations towards reductionist, positivist thinking, where mathematics and data-driven arguments are seen as superior to arguments based in more expansive thinking about society and values. Riley also notes the centrality of military and private profit-driven organizations within engineering work that tends to infuse engineering work with managerialism – "viewing human relationships within the organization through a lens of inputs and outputs and increasing organizational efficiencies by minimizing inputs and maximizing outputs (Pawley, 1998)" (Riley, 2008, p. 40). Aligned with Riley, Cech (2014), argues that the culture of engineering is characterized by "three ideological pillars: the ideology of depoliticization, which frames any 'non-technical' concerns such as public welfare as irrelevant to 'real' engineering work; the technical/social dualism, which devalues 'social' competencies such as those related to public welfare; and the meritocratic ideology, which frames existing social structures as fair and just." (Cech, 2014, p. 45).

Building on these insights, Riley, Cech, and others (Slaton, 2015; Leydens & Lucena, 2017) have outlined a cluster of ideas that pervade engineering, which we can label as ***technocracy***. A technocratic stance is characterized by the distinguishing of technical work (based on math and/or science content) from other kinds of engineering work, the valuing of technical work over non-technical work, the accruing of social and/or intellectual capital to those engaged in technical work, understanding this technical work to be uncritically good (i.e., divorced from unintended adverse impacts), and engineering work as devoid of power relations. Critiques of this stance are resonant with insights from science and technology studies, documenting that engineering culture is dominated by technological determinism (Smith and Marx, 1994), a loose cluster of cultural narratives stating that technological development inevitably leads to progress, technical experts know best how to govern new technologies, technology homogenizes cultures, and society adapts to technology rather than shapes it.

Over the last few decades, engineering education scholars have begun to elaborate how technocracy does harm in engineering education. Cech (2014) argued that, over engineering students' course of study, technocratic assumptions contribute to their decreasing sense of the importance of public welfare beliefs in engineering work. Similarly, Bielefeldt & Canney (2016) have documented how technocratic assumptions within engineering programs contribute to decreasing engineering students' sense of social responsibility. Other scholars such as Foor, Walden and Trytten (2007), Secules, Gupta, Elby, and Turpen (2018), Secules, Gupta, Elby, and Tanu (2018), Tonso (2006), and Stevens, O'Connor, and Garrison (2005) have shown how technocratic assumptions are at play in understanding the mechanisms by which some students are pushed out of engineering. For example, Secules, Gupta, Elby, and Tanu (2018) document how technocratic ideas lead student teams in introductory design courses to devalue aspects of engineering design which they deem 'non-technical,' such as project management and report writing, and to marginalize the students whose main contributions involve those 'non-technical' aspects. Such marginalization can lead students to question if they belong in engineering. Along these same lines, Stevens, O'Connor, and Garrison (2005) document the story of a student, Bryn, who finds it difficult to identify with engineering because she saw engineering—defined largely by her experiences in the introductory engineering science courses—as not contributing to social goals of giving back. Bryn sees engineering as neither contributing to her personal growth, nor to building on her ability as a people-person. By contrast, she does find her non-engineering courses, such as English, as better able to support this kind of growth. Tonso (2006) documents how meritocratic considerations that pervade engineering (such as basing opportunities for jobs and internships on grade point averages, and incentive structures in courses) entangle with the socio-technical dualism to produce status differences among members of student design teams. How different teams navigated these status differences influenced how the teams functioned, what they valued in their work, whether they reproduced aspects of technocracy or challenged them, and the distribution of work and credit within the team. Slaton (2015) argues that technocracy as characteristic of engineering, and the narrative of engineering education as based on "meritocratic judgement of eligibility and skills" (p. 171), not only limits access for students from backgrounds traditionally underrepresented in engineering, but also obscures how structural features of society such as ideologies of gender, race, class, and ability contribute to the historic and ongoing asymmetries in who gets to participate in engineering. Further, technocracy and meritocracy entangle with dominant capitalist ideologies to perpetuate one another and to occlude possible inquiry into what purposes the technical work of engineering serve. These entangled ideologies support and are supported by an uncritical view of engineering's processes and products as contributing positively to social welfare. Technocracy, in conjunction with meritocracy and neoliberal ideologies, thus hinders the democratization of engineering and engineering education.

Description of Study Setting

Learning Assistant Model

In the learning assistant (LA) model (Otero, Pollock, McCray, & Finkelstein, 2006; Otero, Pollock, & Finkelstein, 2010), peer educators (who we will now call "LAs") concurrently enroll in a 3-credit pedagogy seminar while also engaging in ~8-12 hours of work per week supporting students' learning within a specific student-centered science, math, or engineering course. We have adapted this model to support engineering LAs specifically (see Quan, Turpen, Gupta, & Tanu, 2017 for more details on our pilot implementation). Currently, all of the engineering LAs in our study work within the same introduction to engineering design course that serves all first-year students considering a major in engineering.

Introduction to Engineering Design Course Overview

In our introduction to engineering design course, students work in teams of eight to construct an oversand vehicle (OSV) that can autonomously navigate a terrain with obstacles and complete one of various missions (described in more detail in Calabro, Gupta, & Lopez Roshwalb, 2015). The first ~5 weeks are primarily a crash course in various content fundamentals (e.g. force, torque, power, circuits, coding), but the final 10-11 weeks involve prototyping, constructing, troubleshooting, and programming the OSV. We observed that many LAs start the semester with a sense that their central responsibility in this engineering design course is to help students overcome technical roadblocks.

In this introductory engineering course, each LA is paired with a different engineering design instructor. These instructors have differing expectations for the length and nature of the LA-student interactions and thereby shape the forms of interaction LAs have with their students. Some instructors strongly emphasize students' growth, including their learning about the engineering design process, and put less emphasis on producing a functioning OSV. Others put more weight on completion of a functional OSV and success within course competitions or public showcases. In cases where an instructor emphasizes completion of a functioning OSV, we observed LAs to be more likely to attend to technical troubleshooting.

Our study involves two coupled contexts as shown in Figure 1–the introduction to engineering design course listed in engineering as ENES100 and a required pedagogy seminar course for the LAs listed in education as TLPL488E. In order to distinctly reference these two course contexts, we call the engineering design course a "course" and the pedagogy course a "pedagogy seminar." Similarly, to distinguish between the students in each of these courses, when we are referencing students from the engineering design course we call them "students" and when we are talking about the students enrolled in the pedagogy seminar we call them LAs. In the cohort of LAs in this study, all were new to teaching within the engineering design course except for one LA, Tony.

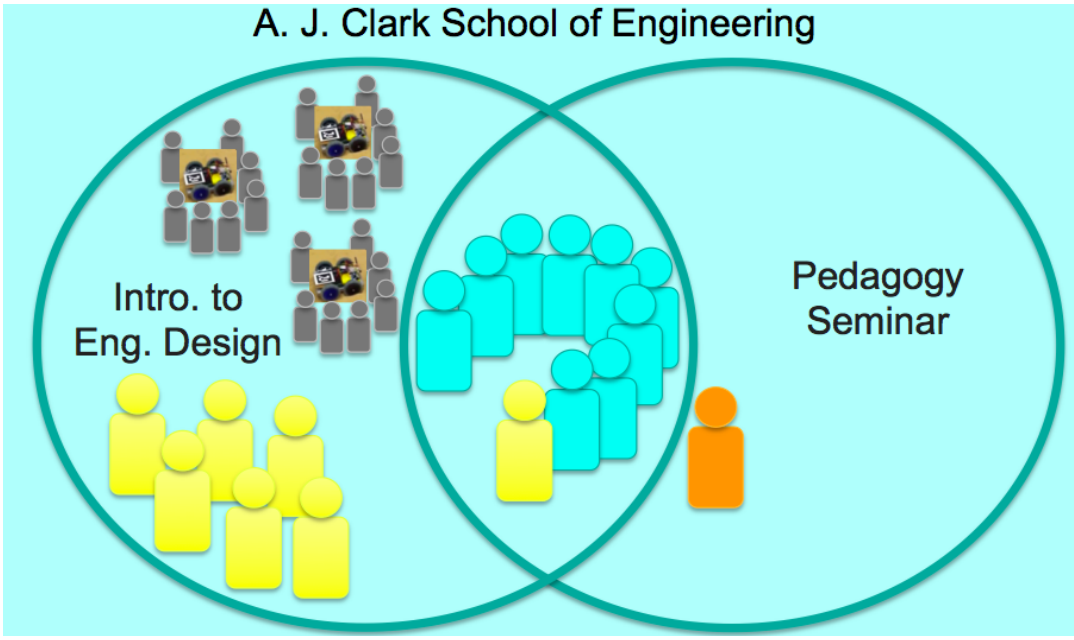

Figure 1 (color): Illustrates two overlapping course contexts and the actors are involved in each space. Students in the engineering design course are shown in grey. The faculty instructors for the engineering design course are shown in yellow and the peer educators (or LAs) are shown in teal. One pedagogy seminar instructor (C. Turpen) that is not directly involved in teaching within the engineering design course is shown in orange.

Pedagogy Seminar Overview

In our previous work, we described the design and pilot implementation of a pedagogy seminar for undergraduate LAs in this introductory engineering design course (Quan, Turpen, Gupta, & Tanu, 2017). Our current work builds off of this foundation, making iterative changes based on formative feedback from our pilot implementation (Tanu, Quan, Gupta, & Turpen, 2017; Quan, Turpen, Gupta, & Tanu, 2017; Turpen, Gupta, Radoff, Elby, Sabo, & Quan, 2018) and insights from a new co-instructor (J. R. Lopez Roshwalb), who had extensive experience (and was concurrently) teaching within the engineering design course.

In our second iteration of the pedagogy seminar for engineering design LAs, we conceptualized the course as having three primary conceptual themes: (1) Theories and strategies for teaching and learning, (2) Design thinking in engineering, and (3) Equity (see the Appendix for a list of weekly readings and links to lesson plans). As mentioned above, all LAs enrolled in this seminar were concurrently working within the same introduction to engineering design course. As a consequence all students were able to bring in concrete "problems of practice" (Horn & Little, 2010) from their teaching experiences into our pedagogy seminar discussions. In addition, during pedagogy seminar discussions, LAs often referred to their prior experiences as learners in that engineering design course.

The co-instructors of the pedagogy seminar (C. Turpen and J. R. Lopez Roshwalb) aimed to create an experience that would be meaningful to the LAs, given their read on the LAs' goals and concerns. As such, the co-instructors framed the seminar as helping the LAs (a) learn how to support their students, (b) learn how to partner with course instructors to improve students' experiences, and (c) develop their engineering skills (e.g reflect on design process, facilitate teamwork, and consider social justice implications). This second iteration of the seminar maintained some of the same learning objectives as the pilot version of the seminar such as (1) identify and critically evaluate claims from readings, (2) carefully observe and document classroom events, (3) analyze classroom events and consider multiple plausible interpretations, and (4) revise own teaching practice and propose changes to the engineering design course (see Quan, Turpen, Gupta, & Tanu, 2017). However, the second iteration foregrounded a few additional expectations such as (5) adopt an inquiry stance toward making sense of your students' learning and your own instructional approach, and (6) attend to issues of equity in working with students. In this most recent iteration of the pedagogy seminar, greater emphasis was placed on these last two goals.

Our pilot implementation of the pedagogy seminar achieved only limited success in helping LAs attend to teamwork challenges within the design teams they were supporting (Turpen, Gupta, Radoff, Elby, Sabo, & Quan, 2018). For example, we observed that LAs often relied on individual accountability narratives in making sense of why some students were not participating or contributing to their team's design work. These explanations typically constructed the less-involved students as lazy or lacking the technical expertise required to contribute. At times, however, LAs in the pilot implementation constructed more humanistic narratives that relied on emergent systems-based explanations. For example, LAs might note how interpersonal dynamics between particular team members jointly produced less access to certain kinds of design work (such as coding) and as a result limited some team members' opportunities to learn about coding (Turpen, Gupta, Radoff, Elby, Sabo, & Quan, 2018). Based on these findings, one of the pedagogy seminar instructors during the second iteration was attuned to individual accountability narratives in LAs' explanations. She would often work to challenge or disrupt these individual accountability narratives when possible.

In response to the shortcomings we identified in our pilot implementation, we realized that the pedagogy seminar needed to take a more systematic and sustained approach to presenting equity considerations within the engineering classroom. In particular, we felt that we needed to expose LAs to the concepts of meritocracy and technocracy while simultaneously acknowledging that these were largely unfamiliar concepts to them and which often felt distant from the pressing "problems of practice" (Horn & Little, 2010) that the LAs were more spontaneously orienting to. In this second implementation of the pedagogy seminar, we (a) introduced these ideas earlier in the semester and more explicitly with the LAs, (b) continually revisited them throughout the semester, and (c) coupled readings about equity with readings about the engineering design process, so students could practice thinking about the two together and to challenge narratives of socio-technical dualism that traditionally treat these topics as distinct and separable. In this way, we worked to make the equity strand more cohesive with the rest of the course content.

We took a multi-tiered approach to engaging students in readings and writing about central course concepts. LAs were given ~2 short articles to read before every class and asked to respond to some reading comprehension questions in writing prior to class. Then in class we discussed the article's main argument and worked through lingering confusions. The LAs then had a short post-class writing assignment to synthesize what they learned.

As an example, we started the equity strand in the second week of the semester by assigning a short and accessible piece by Elizabeth Cohen (1998) that introduces a few key ideas from the theory of Complex Instruction from mathematics education (Cohen, Lotan, Scarloss, & Arellano, 1999). In this brief piece, Cohen introduces the idea that status differences in groups are situational and problematic and that educators should intervene to minimize status differences in groups. Cohen presents two interventions that can serve to minimize status differences: (a) using a multiple abilities treatment (e.g. a task that requires multiple different intellectual ability where no one will have all of these abilities, but everyone will have some of these abilities) and (b) assigning competence to low-status students (in public, truthful, and relevant to the group's work on the task). After reading this short piece, the engineering LAs were asked to respond to the following reading comprehension questions:

1. Cohen introduces the idea of how high and low status emerge in cooperative learning settings. What do you think contributes to social isolation (e.g. low status) and social dominance (e.g. high status) within ENES100 design teams?
2. Cohen talks about how educators can intervene to address status differences in teams. What are some of the strategies educators can use to minimize status differences between students in a group?

Based on some of the lingering confusions expressed in the LAs' pre-class written reflections, one of the seminar instructors briefly presented Cohen's primary argument and then asked students to discuss a follow-up question in class in small groups, "Status problems are situational. What does Cohen mean by this?" with a short quotation from the article. Following this discussion, we had a whole-class discussion about: "What are the purposes of publically assigning competence to low-status students?" In the same week, students were expected to read about how to support divergent and convergent thinking through design feedback (Daly & Yilmaz, 2015). The following week we began to stitch the two readings together by examining how status differences within design teams may contribute to prematurely cutting off divergent thinking.

Students' observational and interpretative work within the engineering classroom was guided by an "inquiry question" that each LA developed in the first few weeks of the seminar. This inquiry question set the direction of investigation for their inquiry portfolios where they worked to document classroom events and students' experiences within the engineering design course. With feedback from peers and instructors, multiple LAs oriented to equity considerations in their inquiry projects. This inquiry portfolio project was loosely inspired by the Knowles Science Teaching Foundation "Practitioner Inquiry for the Next Generation" (PING) program (Stokes, 2014).

The pedagogy seminar instructors paid attention to the patterned ways in which the LAs spoke up or remained more quiet during seminar discussions. The instructors worked to manage this participation and invite more voices in the seminar by explicitly saying things like, "Does anyone have any reactions to what this person said?" The instructors also used these observations to give the LAs explicit mid-semester feedback on their in-class participation. In this mid-semester feedback, some of the more discursively dominating LAs were given explicit feedback to hang back at times and practice active listening. For example on 10/31/18, the instructors gave Theo the following feedback, “You are regularly one of the first to answer a question posed to the class. This can often be helpful in starting a discussion, but we also invite you to sometimes step back and offer wait time for other classmates.” For example on 10/31/18, the instructors gave Tony the following feedback, “You rarely ask questions that inquire into, or invite clarification of others’ ideas. This makes it hard to tell how actively you are listening to them. Consider asking people to say more before publicly expressing strong disagreement with them.” Similarly, some students that were a bit more reserved during in-class discussions were asked to try to find more opportunities to speak up. For example on 10/31/18 the instructors gave Nora the following feedback, “You are sometimes quiet during whole-class discussions, but it is evident from your [*post-class*] writings that you are actively listening and developing your own viewpoints. We encourage you to share more of your own thoughts in the whole class discussions. Your classmates could benefit from hearing even more of your ideas.” We wonder how important some of this in-class and written mid-semester feedback may have been for getting other ideological convergences to emerge later in the course.

Methods & Analytical Approach

Data collection: The pedagogy seminar, which met once a week for 2.5 hours, was video and audio recorded by members of the project team. A single video stream was recorded by a camera at the front of the room, facing the learning assistants (LAs). Multiple streams of audio were recorded, in order to capture each small group discussion. We also collected LAs’ written assignments (e.g., reading reflections) and classroom artifacts (e.g., whiteboard drawings). In addition, field notes were collected by a member of the research team who would often sit in on small group discussions, at times playing a facilitation role. Due to this dynamic, field notes of full-class discussions are more complete than field notes documenting small-group discussions.

Data selection: In this paper, we present illustrative examples of LAs (1) reproducing and (2) contesting aspects of technocracy. These examples come from two full-class discussions in the pedagogy seminar, the first towards the start of the semester and the second towards the end. These moments were selected from an instructor’s recollections (C. Turpen) and an additional researcher’s field notes of salient classroom moments (J. Radoff). Having a general sense of where to look, we returned to the field notes and located these moments in the video records, which were then transcribed by members of the project team.

The first example occurred five weeks into the course, when LAs were discussing how their students’ first assignment went. Both the field-noter and one of the seminar instructors noted this as a moment where LAs used dehumanizing language to talk about some of their former peers (from when they were students in the engineering design course). Returning to this episode, we found that the dehumanizing language was coupled with technocratic narratives.

The second example occurred later in the course, after LAs watched video clips they collected of their own teaching for a “clinical simulation of teaching” assignment. Immediately after the class period ended, both an instructor and the field-noter excitedly noted that this discussion showed some evidence of progress in how LAs oriented to their students' team dynamics. In previous discussions, despite the course instructors' overt focus on the importance of attending to design teams' histories and social dynamics when analyzing and diagnosing teamwork troubles, LAs had been resistant to taking up this pedagogical orientation. During this discussion, however, LAs explicitly referenced the pedagogical utility of attending to social dynamics for supporting teams' design work. Notably, this moment occurred after the LAs had been exposed to a range of ideas about how status differences are constructed in groups and about the role of meritocracy in schooling and on the culture of engineering, which may have influenced what the LAs noticed.

Analytical Approach: After the selected segments were transcribed, as a group we watched the video with the transcript. We would typically stop after 3-5 utterances to build collective understanding of the utterances. This also allowed us to start building interpretations of how LAs were constructing or challenging technocracy (Engle, Conant, & Greeno, 2007). As we watched more short bits of video, we tried to tease apart fine shades of meaning (Siegler & Crowley, 1991) when utterances shared some term or idea. To understand the interactional dynamics of this conversation, we attended to paraverbal features of the utterances (for example, volume, pitch, register) as well as turn-taking, gestures, posture, facial expressions, and the use of hedge words. This multimodal analysis (Stivers & Sidnell, 2005), while informing the discourse analysis, is not included below in our findings.

Drawing from Philip's ideology-in-pieces framework (Philip, 2011; Philip et al., 2018), we operationalized a technocratic stance in an utterance as a cluster of ideas: the distinguishing of technical work based on math and/or science content from other kinds of engineering work, the valuing of technical work over non-technical work, the accruing of social and/or intellectual capital to those engaged in technical work, understanding this technical work to be uncritically good (i.e., divorced from unintended adverse impacts), and engineering work as devoid of power relations. The selected conversational segments were analyzed turn by turn to see how technocracy was being reproduced or challenged. Looking across a short set of utterances, we analyzed how successive utterances get layered to build a convergence towards or away from a technocratic stance. This helped us model how the reproducing or challenging of the technocratic stance was a co-construction among the conversation participants.

To understand how aspects of the course might be influencing the dynamics and progression of the conversation within and across each of the two segments, we relied on field notes from the class as well as reflective notes from one of the instructors (the first author). We attended to the sequencing of course topics and whether and how they built on key ideas around equity and inclusion in engineering culture and in design teams. We also attended to how the pedagogy seminar topics coordinated with significant events in the introductory design course, such as milestone presentations or transitioning from conceptualizing the preliminary design of an artifact to fabrication and testing. These course events influenced LAs' interactions with the students in the design teams. So, our analysis was influenced by our intuition that the sequencing and coordination of pedagogy seminar topics along with design course events influenced how the LAs attended to and interpreted the dynamics of the design teams they were recording in the clinical simulation assignment, depicted in segment 2. We do not present a detailed analysis of how the pedagogy seminar activities were entangled in the reproduction or challenging of the technocratic stance. But in segment 2, we present our interpretation, in brief, of which pedagogy-seminar activities could have influenced the conversation.

Data Analysis

Data Segment 1 - Setting the scene

This segment of talk occurred during week 5 of the term (9/25/18). A pedagogy seminar instructor and nine learning assistants (LAs) are arranged in a large circle where all participants can see one another. As the first activity in this class period, the class debriefs about how a recent major assignment, "Milestone #1," went for their students in the engineering design course. (The Milestone #1 assignment asked design teams to describe in a 10-minute presentation how they will organize themselves around the design tasks over the course of the term.)

About 30 minutes into the debrief, some LAs launch a discussion about the benefits and drawbacks of different team structures for the 8-person design teams—co-led teams, decentralized leadership, specialization, etc. Right before this segment of talk begins, Quinn shares a story about his experience as a student in the engineering design course. He would come to open lab hours intending to work on one subsystem of his team's oversand vehicle (OSV) only to find that multiple subsystems needed work. While troubleshooting, he found that he might get a subsystem or component to start functioning in a desired manner without understanding why what he did solved the problem. Quinn reflects on how this pattern made him more knowledgeable about multiple subsystems, but also constrained his ability to explain to his peers when asked *why* his changes worked. Acknowledging how this prevented his peers from entering into the design work, he said that the pressure of deadlines made it difficult to catch them up. Our transcript begins after Quinn's statement. (We have boldfaced parts of utterances that are significant in our analysis.)

1	Tony: It was just like more efficient to like, do all the wiring and coding by yourself. Cause like, **anyone can like build the OSV** (*oversand vehicle*), so like (Theo: Sure) all I did was like, **it's more efficient for me to do all the wiring and coding and like tell you what to build, than me to go back and explain** like two weeks worth of coding and the mess of wires that I had at that time. (Quinn: Yeah.) It's just way more efficient for me to do everything.
2	Theo: So do we- so, what I'm hearing is that **we don't need 8 people** to do the OSV. We may need like, I don't know, like four people.
3	Tony: **It was me, one person building and one person doing my CADs for me** (Theo: Ok.), and **I just told them what to do** (Theo: Right), yeah.
4	Theo: Right, so, I don't know. And then like the other like four or like five people are just like **dead weight.**

5	Tony: No, they just did all- I told them huh **I'm fine with you guys not doing anything but you have do like all the reports and powerpoints and stuff** (Theo: [laughs] Ok.). I said ok, I'll take this. And then one pers- one or two people like didn't do much and they got (Theo: Sure) destroyed on the peer reviews so-
6	Theo: Right. Yup yup yup. **The natural process.**
7	Tony: Yeah.
8	Theo: So I don't know like, in your [*design course*] experiences did you find like- how many people are dead weight on your teams?
9	Charlotte: It was half of mine who was dead weight.
10	Tony: Half-ish
11	Theo: Yeah. So do we need to like develop like more missions for people to do. Or like, have like, you know cut groups into like four and then have like people doubled up or something?

Table 1: Transcript of "dead weight" episode of pedagogy seminar discussion with turns of talk indexed in the left column.

Data Segment 1 - Analysis

In Turn 1 (T1), we see Tony cuing up narratives of efficiency and beginning to define various forms of labor within design teams in the engineering design course. He describes some forms of labor that "anyone can do" (e.g., building the transportation system of the OSV) and other forms of labor as requiring more specialized expertise, such as wiring and coding. He describes delegating the building work to others, and not finding it worth his time to catch others up on his wiring and coding work. At the end of T1, Tony says, "It's just way more efficient for me to do everything." In calling his wiring and coding work "everything," Tony in effect minimizes or makes invisible all other forms of work. Simultaneously, this elevates "efficiency" as a metric that should centrally justify their work routines.

In response to Tony, Theo in T2 continues with this efficiency narrative and begins to question whether teams even need 8 students on them to do the necessary work. Here we see Theo describing a more systemic reason for teammates not contributing—that there may not be enough work to go around—and he wonders whether minimizing inputs (e.g., people on a team) would require more active engagement from non-contributing teammates in order to produce the "same" output (e.g., a functioning OSV).

In T3, Tony further differentiates forms of work, stratifying labor into categories of "building," "CAD drawing," and his own work of coding and wiring, which he implies requires more expertise. His use of pronouns marks himself as having ownership over the entire project, and casts his peers as merely following his orders. In response, Theo in T4 casts the other 4-5 teammates as “dead weight” within the team, reducing some team members as inert and burdensome due to their limited work contribution.

In T5, Tony disagrees with Theo’s casting some team members as dead weight, but highlights their utility as limited to report writing and preparing powerpoint presentations. While Tony distinguishes these team members from the one or two people who “didn’t do much” and got “destroyed on peer reviews,” he also describes these forms of work as “not doing anything,” thus minimizing and erasing the powerpoint/report creation from the core work of designing the OSV. In T5, Tony describes himself as having a certain degree of authority to delegate tasks to peers, while simultaneously constructing those delegated tasks as more menial and as requiring less expertise, which harkens back to “telling” others what to do in T1 and T3.

In T6, Theo affirms Tony’s statement, and describes it as “the natural process,” and in T7, Tony agrees. In T8, Theo turns to the rest of the participants and asks them “how many people were dead weight” in their design teams. In T9 and T10, Charlotte and Tony affirm that about half of their teams were dead weight, thus contributing to the joint construction of some team members as “dead weight” and establishing it as a common problem in the engineering design course.

Responding to this co-constructed “problem” of “dead weight” teammates, Theo follows up in T11 with a few tentative solutions, which function to increase efficiency by either maximizing output (e.g., “more missions”) or minimizing input (e.g., “cut groups into four” by which he means forming two 4-member groups). In this moment, Theo seems to be attending to systemic features which may create the conditions for “dead weight.” While still dehumanizing for the individuals being referenced, Theo isn't seeing this as an internal trait but as something that could be produced, in part, from structural aspects of the environment in which teams are working.

We acknowledge that the instructor in this space is contributing to these temporary convergences as she does not interrupt and mark this language as dehumanizing in the moments recounted above. We also note that this discussion continues beyond the moments documented here, so in some ways this convergence is local to these moments, rather than stable across time and contexts. In some of the immediate exchanges that follow, some LAs, who did not speak in the moments documented above, and the seminar instructor offer reframings that at times challenge aspects of technocracy. These alternative stances weren’t fully explored in class due to the instructor’s moves to wrap up the discussion driven by a sense that the activity had taken much longer than expected.

Data Segment 1 - Discussion

Constructing the sociotechnical divide and reproducing technocracy: Across the exchange in Table 1, we see Tony and Theo stratifying different kinds of labor and, in the process, reproducing the socio-technical divide. Labor is divided into (a) wiring, coding, and designing versus (b) building OSV transportation system, developing CAD diagrams, and report writing. Furthermore, (a) is valued over (b). In assigning more value to what’s commonly seen as more technical work, we see Tony and Theo reproducing technocratic ideologies at least in these moments. The team members who contribute to lower status tasks never have access to the higher status work and therefore aren't seen as developing expertise in this higher status work. From this ideological stance of there being more or less valuable work, the people doing no work or the less valuable work are cast as "dead weight."

Reproducing managerialism: In Donna Riley's book "Engineering and Social Justice," she draws attention to the dominance of corporate or industrial influences in engineering, which results in a preponderance of managerialism. "Managerialism takes a systems approach to organizational management, viewing human relationships within the organization through a lens of inputs and outputs and increasing organizational efficiencies by minimizing inputs and maximizing outputs (Pawley, 1998)" (Riley, 2008, p. 40). We see this managerialism reflected in data segment 1. Across multiple turns of talk, Tony and Theo rely on efficiency as a central metric that should justify a design team's work routines. This efficiency theme often plays out with "tradeoffs" based reasoning—justifying prioritization of getting the OSV functioning over developing one's own understanding and over bringing one's peers along in the process.

Entangling meritocracy and technocracy: In this segment, we also see evidence of entanglement between technocracy and meritocracy, as others have theorized (Slaton, 2015). As LAs stratify labor and place differential value on some forms of labor, this lays the foundation for justifying the stratification and rank-ordering of people. In T5, Tony describes himself as having authority to delegate lower-value tasks to peers. So, his construction of different forms of work as rank-ordered in terms of value goes along with a rank-ordering of *people* as more vs. less valuable to the team—more vs. less meritorious. This is further perpetuated when multiple LAs report on the prevalence of "dead weight" team members within their own design teams (T9 & T10). This constructs a meritocratic system where the warrants for merit are based on technocracy.

Data Segment 2 - Setting the Scene

Towards the end of the term (11/13/18), as a part of a "clinical simulation of teaching" assignment, LAs provided extended support to a subteam that was working through a non-trivial design challenge in the engineering design course. The LAs were told not to solve the problem *for* the team, but rather, to support students in working to figure things out for themselves. The written assignment description instructed LAs to "go in with an awareness that other factors could be contributing to the team's design challenge, such as team interactions or socio-technical problems."

LAs submitted video recordings of their teaching episodes to the seminar instructors, who then selected a subset of the videos to watch and analyze together in class. After each video played, LAs discussed what they noticed. In these discussions LAs noted a variety of things, including the quality of students' design work, teams' group dynamics, and how LAs interacted with their students.

After watching and discussing the last video, LAs were asked to make connections across the set of videos and reflect on what they could learn from this activity. During this discussion, a few LAs described an insight they had—that observing a team's social dynamics informed how they understood, diagnosed, and helped teams solve what had initially appeared to be technical problems. Below, we analyze a few turns of talk from that discussion. .

Data Segment 2 - Analysis

About ten minutes into the synthesis discussion, one of the LAs, Nora, reflects on how a dominating teammate could disproportionately influence the team's approach to a design problem:

> Kind of going off of like **the whole group dynamics discussion**, like, I thought it was interesting in Kurt's video how you know now that we found out that uh *Student1* was like 30 [*years old*] and there was not tension but there was kind of like, maybe, some awkwardness because of the I don't know like, he kind of- **he wanted to go with his design** and then in my video with *Student2*, like, they're all like friends but *Student2* was really **dominating the conversation** and like **he wanted to really go with his idea. I think it was interesting to kind of see how like group dynamics affected you know like how these teams like approached their problem**.

Here Nora notes that a group's interpersonal and relational dynamics, like awkwardness due to an age gap, or a loud student's enthusiasm for their own idea, might influence a group's decision design to pursue one design solution over another. A major design element of the pedagogy seminar is helping LAs learn how to support their students' equitable participation in design work. This goal is challenging, however, since LAs tend to orient to their role as providing technical support rather than helping students develop routines for healthy group dynamics. Here we see Nora diverging from this orientation by not only commenting on a group's social dynamics, but also by explicitly referencing the pedagogical utility of doing so. Immediately after Nora speaks, Charlotte adds:

> **And then also about the group dynamics.** Ok, we didn't see my video but then the one thing that I noticed when I was taking that video was kind of like **the first time where I spent like a long period of time interacting with one group** [laughter]. And then, there was like, it wasn't even apparent in my video cause I was **discussing a problem with the coding subteam.** … **I saw the team dynamic**, I guess. How like the different subteams were working like independent of me interacting with them, **and just observing them**. And it was like very diff- **Cause that was supposed to be one of the more productive teams but then it kind of also showed where like whatever problems they may be having, like you saw kind of lack of communication and lack of equal effort between the subteams. I got to observe that and see like, oh, that might be causing some of the difficulties that you're having but then they don't realize it.**

Here, Charlotte describes discussing a coding problem with a subgroup of a supposedly "more productive" team. Observing them, she realizes that their technical problem could be traced to (1) lack of communication between subteams, and (2) inequitable (or unequal) division of labor between subteams. Charlotte shares that the subteams were unaware that their technical problems were caused by dysfunctional team dynamics—an insight made possible by the extended time she spent with the team.

After Charlotte shares, one of the seminar instructors asks the LAs to reflect on the issue of having limited time to interact with teams. After a few people have commented, Quinn refers back to Charlotte's contribution:

> Quinn: So kind of going off Charlotte's point, like understanding like, the **inner-team issues**, something I noticed from **a lot of my teams** is like, **I'll get individual questions, then I'll start realizing that they're all related to each other.** So like, just today, I had like two different teams, someone would ask me about implementing the overall code, and **I'll just say like, have you talked to this other team member on your team, because they're working on the motor driver, and they haven't talked to them.** So then I'll bring it back to the table and **once I start explaining it, then like, the other teammate like understands what's going on. They can like, they start like working together, and I don't really have to help them anymore cause like, their teammate can answer all their questions.** So it's just like, they didn't understand like, **they're like working on separate projects that they have to collaborate on. And like, once like, I explain that to them, they knew what was going on.**

Here Quinn describes a problem he encounters with "a lot of teams." He notes that team members often ask him technical questions (e.g., about implementing code) that could be answered by members of other subteams. However, students may not realize they are working on "separate projects they need to collaborate on." In some cases, Quinn addresses this problem by merely drawing attention to the lack of communication between subteams; after which, he often finds that he no longer needs to provide technical assistance.

The realization that a social intervention (such as bringing two subteams into communication) might help solve a technical problem allows Quinn to imagine instructional interventions that support the team's progress in their design work while also minimizing their reliance on him as an authority figure.

Data Segment 2 - Discussion

The clinical simulation assignment helped construct the context for LAs to sit with a design team for an extended time period. Many LAs were used to dividing their time among four or five teams, not spending too long with any single team. Indeed as Charlotte noted, this was "the first time where I spent like a long period of time interacting with one group." The extended time allowed her to see what "might be causing some of the difficulties that [*the team is*] having but then they don't realize it." So, the pedagogy seminar assignment created a context that allowed LAs to "see" and reason about previously invisible team dynamics. For example, Quinn says "I'll get individual questions, then I'll start realizing that they're all related to each other." As Quinn spends more time with a team, he realizes that the questions he's receiving are connected. By staying with the group for a while, Charlotte and Quinn (and other LAs) got to see how teams work together, not just what they are working on.

These examples of engineering LAs re-diagnosing seemingly technical problems as team dynamics problems demonstrate that undergraduate engineering students can construct stances that challenge aspects of technocracy, particularly the socio-technical dualism. The LAs challenge this dualism in a variety of ways. Nora reveals that design decisions can be understood through a lens of social and interpersonal dynamics, not just through the technical merit of the design idea. Nora elaborates how the social group dynamics, such as an overbearing student, can truncate the process of collaboratively fleshing out and judiciously weighing the pros and cons of many different ideas. Charlotte discusses how a problematic culture of work within a group—such as not reaching out for help, inadequate communication between subteams, etc.—can manifest as technical problems. Quinn talks about how social interventions, such as opening a line of communication between the subteams, can solve the technical problems a team faces. We see this as a shift from earlier in the semester, when LAs were quick to jump in and give answers to technical problems without seeking out more information about how the teams were operating. Here, they don't micromanage students' roles or information flow; rather, they merely bring the group's attention to the communication breakdown, thus bringing their students into the work of repairing the dysfunctional social dynamics. Furthermore, by talking about social and technical dynamics as fundamentally entwined and by not elevating one's value over the other, the LAs are challenging narratives of social-technical dualism, and hence technocracy.

We note that in these examples, the LAs started attending to a team's social dynamics when the social dynamics seemed to be getting in the way of the oversand vehicle (OSV) working and functioning. Nora talks about how the loudest ideas tended to get taken up. Charlotte talks about how problems that seemed technical were actually social. Quinn discusses how he solved several technical problems with one social solution. By contrast, we rarely saw LAs attending to social dynamics that disrupted students' opportunities to learn but weren't explicitly disrupting progress toward completing the OSV. This is important because the LAs' patterns of attention and intervention could send tacit messages to students that attending to team dynamics is important only if the design of the artifact is under threat, reifying the elevated status of the artifact over human relations.

Conclusion

We have given empirical examples of what it looks like for engineering learning assistants (LAs) to both (re)produce and contest technocratic stances in reasoning about engineering education. We believe that such empirical examples are important in that they help engineering educators to hone their attention to student thinking in the classroom and help us to understand what it might look like to see evidence of growth or progress in students' reasoning along this dimension.

We would like to caution readers, however, not to flatten these examples into a monotonic account of change/progress from technocratic stances to non-technocratic stances. This is not our goal. In early *as well as later weeks* of the course, a multiplicity of technocratic and non-technocratic stances emerged. Early on in the course, however, this multiplicity of stances often resulted in convergences toward technocratic stances. For example, in data segment 1, there were multiple non-technocratic stances shared (see our summary of Quinn's storytelling) prior to the "dead weight" segment, though the conversation ended with the technocratic convergence illustrated above. In future work, we hope to analyze these discourse dynamics in more detail to illustrate how non-technocratic and technocratic stances emerge in classroom discourse and how these stances converge in collective dialogue. These future analyses may provide educators with fruitful insights into how to set up classroom contexts that actively disrupt convergence on technocratic stances.

By highlighting data segment 2, we aim to illustrate a convergence around a non-technocratic stance regarding LAs' interpretations of problems they observe in their students' design teams. We hope that these cases illustrate what it might look like for students to construct or converge on stances that challenge the socio-technical dualism and hence technocracy. We find this conversational segment salient not just because of the non-technocratic convergence but also because the LAs strongly endorsed the pedagogical value of noticing and intervening in the social dynamics of the design teams.

As instructors and investigators embedded day-to-day in this instructional setting, we see this convergence around a non-technocratic stance as unlikely to emerge early in the course. Given the broader culture of engineering education in which the LAs are embedded (and succeed!), we also see the non-technocratic convergence as unlikely to have occurred without the support of the pedagogy seminar curriculum. We acknowledge that we have not substantiated these claims empirically. Still, we have strong intuitions that had we brought these same video clips to the LAs earlier in the semester, they would not have noticed the same dynamics or offered the same interpretations. So the non-technocratic stances expressed in data segment 2 were one marker of success for our seminar design team and seminar instructors.

As we continue to pursue a design-research project around this pedagogy seminar, we would like to revisit the ways in which we gave formative feedback to the LAs about their participation in seminar discussions. After providing such feedback, different patterns of in-class participation emerged. The LAs who were most vocal at the beginning of the term were still contributing later on, but became less discursively dominating. Similarly, quieter students were speaking up more and their voices are reflected in data segment 2. We wonder if these changes in discourse participation patterns contributed to different convergences later in the seminar. We note that though we observed episodes of non-technocratic convergences later in the seminar, these non-technocratic stances were not stably present even at the end of the seminar.

Upon more holistic reflection on the course, there was often more LA buy-in around attention to social dynamics when the social dynamics seemed to be getting in the way of producing a functional oversand vehicle (OSV). We found it to be harder to get LA buy-in around noticing and intervening in problematic social dynamics when it wasn't interrupting the OSV production (but was still disrupting access to learning opportunities). For many LAs, even at the end of the course, influencing team dynamics was seen as outside the scope of their role. As we continue to iterate on this pedagogy seminar, this is a goal we would like to prioritize more. We are also considering how changes to other aspects of these coupled systems may be possible, such as framing of the LAs' job description (foreground supporting learning, rather than just offering technical support), LA recruitment efforts, and potential changes to the engineering design course itself.

Upon reflection on the seminar, we observed many moments when LAs were seemingly caring for students and empathizing with them by imagining what might be happening in their personal lives that may influence their participation in the engineering design course. However, we felt that LAs made less progress in thinking about and identifying structural patterns of inequities and seeing how they play out in engineering education in unjust ways. While this pattern indicates some success in moving people away from "individual accountability" narratives that cast students as lazy, etc., and towards more "emergent systems" explanations (Turpen, Gupta, Radoff, Elby, Sabo, & Quan, 2018), this shift did not uniformly produce humanizing accounts.

While we are somewhat hopeful about the convergences around less technocratic stances that occurred toward the end of the semester, we also want to acknowledge that the construction of non-technocratic stances is importantly different than (1) seeing technocracy in the discursive construction of others around you and (2) coming to acknowledge the harm that technocracy is doing to engineering students. In this way, we have only shown what it might look like for engineering students to produce non-technocratic stances, but not what it would look like for engineering students to be well-versed in critical social theory such that they could see technocracy at play, map out its resultant harm, and achieve robust stability in their non-technocratic stances. It is likely that additional skills in social critique would be necessary for challenging technocracy more fully and disrupting it as a mechanism of marginalization.

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Appendix

The table below provides the schedule of weekly course readings and hyperlinks to lesson plans for the pedagogy seminar course. We categorize how each week's readings contribute to three particular themes that we wanted to build competence around in the pedagogy seminar: (1) Theories and Strategies of Teaching and Learning (T&L) as pertaining to tools for thinking about one's teaching work, the sociology of schooling, and students' learning; (2) Equity and Inclusion (E&I) as pertaining to issues of equal access to opportunities and empowerment, (3) Engineering Design (E.D.) as pertaining to design thinking and engineering design practices. Course materials for this semester's implementation can be found here in a public access Google Drive folder.

Week	**Theme** Learning Assistants' Pedagogy Seminar: Course Readings	T&L	E&I	E.D.
1	**Introduction** (Lesson Plan)			
2	**Learning and Knowing** (Lesson Plan) Redish, E. F. (1994). Implications of cognitive studies for teaching physics. *American Journal of Physics*, *62*(9), 796-803.	X		

	Felder, R. M. (2012). Engineering education: A tale of two paradigms. *Shaking the foundations of geo-engineering education*, 9-14.			
3	**Status in Groups + Generating Divergent & Convergent Thinking** (Lesson Plan) Cohen, E. G. (1998). "Making cooperative learning equitable." *Educational Leadership, 56,* pp. 18-21. Daly, S. R. and Yilmaz, S. (2015). "Directing Convergent and Divergent Activity through Design Feedback." In *Analyzing Design Review Conversations* edited by R. S. Adams, and J. Siddiqui. West Lafayette, Indiana: Purdue University Press.	X	X	X
4	**Designing for Proudness + Stereotypes & Implicit Bias** (Lesson Plan) Little, A. (2015). Proudness: What is it? Why is it Important? And How Do We Design for It in College Physics and Astronomy Education? *STATUS: A Report on Women in Astronomy,* Newsletter published by the American Astronomical Society, June 2015 issue. Hill, C., Corbett, C. & St. Rose, A. (2010). Why so few? Women in Science, Technology, Engineering, and Mathematics. American Association of University Women. **ONLY Ch. 3, Ch. 4, & Ch. 8**	X	X	
5	**Productive Seeds of Design Thinking** (Lesson Plan) Hammer, D. (2004). The variability of student reasoning, lecture 1: Case studies of children's inquiries. In Proceedings-international School of Physics Enrico Fermi (Vol. 156). IOS Press; Ohmsha; 1999. Brown, T. (2008). Design thinking. *Harvard Business Review*, *86*(6).	X		X
6	**Synthesis Week** (Lesson Plan)			
7	**Ideology in Engineering Education** (Lesson Plan) G. Ladson-Billings, (2006). "From the Achievement Gap to the Education Debt: Understanding Achievement in U. S. Schools." *Educational Researcher, 35*(7), pp. 3-12. Cech, E. (2014). "Culture of Disengagement in Engineering Education?" *Science, Technology, & Human Values.* ***39***(1), pp. 42-72. **EXCERPT ONLY FIRST 8 pages,** Stop reading at "Professional Socialization in Engineering Education," pg. 49. Brinkworth, C. (2016). "The Myth and Reality of Meritocracy." Posted on the Women in Astronomy blog.	X	X	
8	**Metacognition and Reflective Decision-making** (Lesson Plan) Schoenfeld, A. H. (1987). "What's All the Fuss About Metacognition." *Cognitive science and mathematics education*, p. 189. Wendell, K. B., Wright, C. G., & Paugh, P. C. (2017). Reflective Decision-Making in Elementary Students' Engineering Design. *Journal of Engineering Education, 106*(3), pp. 356-397.	X		X
9	**What makes for successful teams?** (Lesson Plan) Duhigg, C. (2016). "What Google learned from its quest to build the perfect team." *New York Times Magazine..*		X	X

	Woolley, A. & Malone, T. (2011). "What makes a team smarter? More Women." *Harvard Business Review.*			
10	**Peer collaboration at work and school** (Lesson Plan) Smith, M. K., Wood, W. B., Adams, W. K., Wieman, C., Knight, J. K., Guild, N., & Su, T. T. (2009). Why peer discussion improves student performance on in-class concept questions. *Science, 323*, 122-124. Kirkpatrick, J. (2014). "The Best Part of My Week." Re-posted Nov. 12, 2014 from The Women in Astronomy Blog.	X		X
11	**Tinkering in the engineering classroom** (Lesson Plan) G. Quan and A. Gupta (under review), "Tensions in the Productivity in Design Task Tinkering." submitted to *Journal of Engineering Education.* An earlier version of this work was published as: Quan, G., Gupta, A., (2015) Tensions in the Productivity in Design Task Tinkering - *Proceedings of the 122nd American Society for Engineering Education Annual Conference and Exposition.* Seattle, WA: ASEE.	X		X
12	**No Readings - Inquiry Project + Video-recording of Teaching** (Lesson Plan)			
13	**No Readings - Inquiry Project + Thanksgiving Break**			
14	**The floor is uneven** (Lesson Plan) C. E. Foor, S. E. Walden, & D. A. Trytten, (2007). "I wish that I belonged more in this whole engineering group: Achieving individual diversity." *Journal of Engineering Education,* p. 103-115. B. Danielak, A. Gupta, & A. Elby, (2014). "Alienating Deep Learners." In JEE Selects, ASEE Prism Magazine, March 2014 Issue. S. Secules (2017). "Beyond the diversity status quo." Accelerating Systemic Change Network (ASCN).	X	X	
15	**No Readings - Final Poster Presentations**			