

AC 2007-1964: WHY PEDAGOGY MATTERS: FACULTY NARRATIVES

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Why Pedagogy Matters: Faculty Narratives

Abstract

Some authors have argued that a feminist pedagogy in engineering courses could invigorate engineering curricula and improve classroom climates, particularly for women and other underrepresented students. Feminist pedagogy is especially concerned with the hierarchical dimensions embedded in the learning context which can create “chilly climates”, limiting educational possibilities. Few formal studies have been conducted, however, investigating the actual practices utilized by engineering faculty within the classroom. Using qualitative data from 26 engineering faculty members employed at four-year universities, we examine how engineering educators conceptualize effective teaching methods. Their beliefs about effective teaching are compared with existing literature about alternative approaches to effective teaching, theorized by “feminist pedagogy” researchers.

The data suggests that engineering educators in our sample exhibit a range of beliefs about how to achieve effective teaching. Some strongly condemn a “lecture-only” approach for reasons that clearly overlap with a feminist pedagogical model. Feminist pedagogy experts place an overt, and reflexive, emphasis on context in order to address relations of power embedded in the classroom structure. Because “climate” is an elusive and tricky topic to tackle in engineering education, our data incorporates voices from a range of professors to present a few perspectives and practices that address this important issue.

1. Introduction

While undergraduate engineering programs nationwide have made considerable strides to encourage greater numbers of women and minorities in the field, researchers are increasingly interested in identifying the variables that specifically relate to retention of students. The so-called, “leaky pipeline”¹ example (students “switch” out of engineering to other majors) remains important to consider: why do students leave engineering programs? One variable identified by some researchers, such as Seymour and Hewitt,² points to faculty practices in the classroom. Few studies, however, have sought to critically examine the methods used by,^{3,4} and cognitive beliefs of, faculty who employ them. How do faculty conceive of effective teaching? Do these conceptualizations take into consideration student attrition rates? Feminist pedagogy explicitly addresses the need to achieve a “more hospitable place” for all students.⁵ How can this body of literature contribute to contemporary discussions in engineering education? Is it a useful paradigm to inform curricular change? The value of feminist pedagogy to engineering education lies in its explicit focus on creating a student-centered classroom context as a tool to enhance the learning process. In this work, we explore the specific tactics used to achieve this goal.

We begin the paper with a brief review of the tenets of feminist pedagogy. We then explore the relationship between engineering education and feminist approaches to teaching. Next, we describe our research method and data analysis from our study of how engineering faculty describe effective teaching approaches. We conclude with a brief discussion of the implications of pedagogy for engineering education.

2. Feminist Pedagogy-what is it?

2.1. Literature

Feminist pedagogy is a method of teaching grounded in feminist values. It began in the 1960s as a result of second-wave feminist critiques of educational systems seen as reproducing the sexist systems found in the larger society. Feminist pedagogy has evolved and continues to evolve. For example, third wave feminists included not only issues of sexism but its intersection with other categories such as racism, classism, homophobia, etc.⁶ Contemporary feminist pedagogy is not just pedagogy for women. In fact, it may be described as using

gender as a tool of analysis, [however] it is not gender specific. Rather it opens up opportunities for all students to engage ideas and course materials in innovative and transformative ways. Feminist pedagogy resists the assumptions of a de-raced, de-gendered, de-classed student and instead acknowledges the influence that social locations have on histories and styles of learning.⁷

While “feminism” is characterized by a broad heterogeneity of perspectives and diverse theoretical frameworks, “feminist pedagogy” at its core addresses the specific practices relating relations of power, both as central to organizing classroom relations and in producing/sharing knowledge. Feminist teaching practices represent a “stance”⁸ in which specific classroom strategies address issues such as reformation of the relationship between teacher and student, empowerment, building community, privileging voice, respecting diversity of personal experience, and challenging traditional views.⁹ It also includes teaching in ways that¹⁰

- Acknowledge experiences of historically marginal groups, and treat them as normal
- Use feminist principles in the classroom, and use them to inform the content
- Empower students
- Reject the “open and pour” method of teaching
- Insist that learning is more than memorizing content
- Emphasize that learning skills such as critical analysis can be applied to all disciplines and experiences inside and outside of the classroom
- Connect students’ lives to the content of their discipline
- Seek to include rather than exclude students and their experiences
- Strive to make knowledge part of a student’s world, not separate from it.

Feminist pedagogy strives for a more egalitarian classroom where power is shared between teacher and student learners; this must include self-reflection of teachers, acknowledging teachers and students as learners and knowers thereby seeing the role of the professor more as guide than expert and valuing the voices of individual students.

Rather than serving as the all-knowing deliverer of truth, the teacher is a guide for student learning... While teachers are encouraged to enrich syllabi by choosing materials that will appeal to a wide range of students and that cover areas that include the students’ subjectivities, students are encouraged to comment upon and negotiate syllabi, course materials, course requirements, and assignments, and to determine how classroom interaction will take place.¹¹

2.2. Feminist teaching practices

In keeping with a feminist approach, we sought to complement the rich literature on feminist pedagogy using a “purposive sampling” technique¹² to inductively understand *how*, specifically, some of the objectives of feminist pedagogy are met. What specific tactics are used in the classroom to achieve the goal of a de-centered, less authoritarian and more welcoming environment? A small number (six) of in-depth, richly-detailed interviews were conducted with tenured or tenure-track faculty members at four year institutions who are practitioners of feminist pedagogy. The sample included equal numbers of males and females and various academic departments including humanities and social sciences.

De-centering the classroom, that is, restructuring the stereotypical balance of power and authority can take many shapes. For example, *physical* mechanisms can be used to transform a classroom environment. One male respondent creates a communal environment by navigating the space in the classroom:

One of the things I do is I’ll walk all around the classroom and you can say, ‘students don’t just look at me when you’re talking but feel free to look around the class.’ You can say that but they won’t remember it; they’ll just look at me. They’ll just think it’s this one-on-one transmission and I want to encourage the idea that it’s a collective experience so I’ll walk around the classroom, just if anything to get people to turn around and realize you’re in a room with people instead of just looking at someone as though they’re on television.

Another female professor restructures the arrangement of desks:

Sitting in a circle represents a de-centering of the typical hierarchy between the professor and the students. If students are simply sitting in rows, everybody’s facing the professor all of the attention is on the professor as the sole source of authority; in that case you have a very rigid relationship of power between the professor and the students. I prefer for the students to see one another and to sit among the students as a representation as myself as one among many learners, as I feel that I have much to learn as well from what the students can contribute. ... So the seating arrangement I think is one physical marker that demonstrates that approach, that idea of sharing power with the students.

To some, such minute and mundane examples may appear trivial. What is notable, however, is the self-reflexivity involved in considering such dynamics. Certainly psychologists and other social scientists have theorized how personal space affects social relations. The challenge for many university professors is to deliberately consider the seemingly inconsequential details that makeup the daily classroom experiences of an average student. How can a “chilly” climate be made more hospitable?

The mundane can have a totalizing effect on student perceptions. The use of first names in a classroom can be a tool in creating community. Several participants mentioned this tactic, as did this one male professor:

One major thing that I consider to be both feminist and inclusivist and possibly liberative is that I make it an intentional effort, I always use students' first names... I remember in one of my classes I taught at [names large tier-one university], and my classes were much larger and it took me a long time to remember the names. I remember my students were actually really annoyed because before every class I would spend about five minutes just using my little techniques of having name cards and trying to like, match names and faces. And invariably when I got feedback by the end of the quarter, they all appreciated that because they recognized the role in using first names ... It helped to personalize people's presence in the environment. And I also request, I don't insist but I request, that students always use my first name as well. I think that is a specific technique that creates a kind of common humanity like 'We're here together.' ... And that seems like a really insignificant thing ... but I think it actually sets up an entire set of dynamics that changes the trajectory of the student-teacher relationship. It's not that I undermine my own authority as a professor. It's just that I don't assume that my authority is vertical; I assume that my authority is simply an experiential matter and it's much more horizontal.

Here we see that this professor focuses on setting the classroom tone in order to make a deliberate attempt at creating community between himself and his students. The latter portion of the quote also indicates his role as fellow community-member among students. The reflexivity involved in making a conscious effort to communicate interpersonally, on a first-name basis, with his students demonstrates one dimension of feminist pedagogy in practice.

The practice of reducing threat in the classroom is one that is also addressed by feminist pedagogy theorists. Here the female faculty member addresses the need to create community to improve the classroom climate:

The emphasis on discussion would be another practice that I like to employ. In that sense what I try and do is make sure all the voices are heard, the idea of voice is really important to me because I think that some people by their very nature are shy or reserved and it's important to me that they have a say, because if they're shy in my classes it's likely that they never speak. I try to make it easy for people -- I think I try to make them very comfortable. I call them by their names; it's important to me that I know everybody's name. I want them to know each others' names because I like creating an atmosphere of community in the classroom. I don't want them to come to the class and dread it. I want them to come to the classroom and feel comfortable... I want them to *own* the class in a sense.

This sense of "ownership" reiterates the goal of achieving equity among students; that is, if students feel as if they are stakeholders in the classroom, and are viewed as equal and valid co-participants, they will have be empowered to ask questions and feel less intimidated, especially if they occupy a minority status.

"Being open to challenges from students" is a hallmark of feminist pedagogy. The ideal suggests that the professor is a partner among students, not one assuming an omniscient authority position. Having an open stance to questioning and critique, however, is difficult to achieve;

nearly all feminists interviewed for this project acknowledged the challenges embedded in attempting to achieve, on the one hand, a balance between earning the respect of students in order to guide them and, on the other, negotiating an egalitarian role among students.

From this qualitative data (based on the feminist pedagogy participants interviews and the literature), a list was developed indicating pragmatic efforts used in the classroom. Many of these specifically address issues of power, a key tenet of feminist pedagogy. These practices are listed in alphabetical order in Table 1.

Table 1 Feminist Teaching Practices

Allowing questioning of course content; critique of what is being learned in class
Attention to gender & use of inclusive language in examples
Building a sense of community in the classroom
Community Service Learning
Electronic discussions (list-serve or internet-based course software ex. WebCT)
Emphasis on discussion and student voices
Empowerment of students; student as equal partner in learning
Inquiry/inductive learning (driven by a question)
Linking relevant course material to broader socio-political/environmental issues “intersectionality”
Making course material relevant to person experiences; incorporating student voices; use of narratives/stories
Role of professor is guide, rather than expert; professor shares power with students
Self-awareness of professor (make adjustments based on student feedback)
Small group work in class
Students help shape the syllabus
Student presentations; allowing students to occasionally teach the class
Use of multimedia (new technologies, films, music, Tablet PC excluding PowerPoint)
Use of space; consideration of seating arrangement in class
Use of examples relevant to students, Example: popular culture

3. What is the relevance of feminist pedagogy to engineering education?

Given that feminist pedagogy has been shown to be beneficial in creating a more hospitable place for all students, especially women,¹³ feminist pedagogy may offer insights into how to expand the diversity of engineering classrooms. A few researchers have begun exploring how feminist or liberative pedagogies could be used in engineering education.^{14,15,16,17} By exploring faculty attitudes, researchers can work towards understanding classroom climate and suggest strategies for helping engineering faculty incorporate feminist pedagogy into their classrooms.

Some engineering educators may suggest that the term “feminist pedagogy” is too politically loaded to be useful; this may be true. We assert, however, that there is an elementary form of power in coining a term. Because the principles outlined above were established through a legitimate field of theoretical inquiry, feminist theory, it seems appropriate to maintain the integrity of the term. As with any area of scholarly inquiry, feminist pedagogy is evolving.

Stemming from many sources, other scholars of pedagogy interested in similar veins also refer to such approaches as “liberative”, “inclusivist” and “equitable”. These approaches draw from the women’s movement,¹⁸ collaborative learning,¹⁹ Paolo Friere’s “pedagogy of the oppressed,”²⁰ and John Dewey’s ideas of democracy and education,²¹ among others. Like the field of engineering education, “...feminist pedagogy is still defining itself through a process of questioning beliefs and practices in education.”²²

There have been numerous excellent programs aimed at improving the climate and experience for women and underrepresented minorities in undergraduate programs. However, few programs explicitly address teaching practices, in part because large research universities invariably reward faculty members more for research than for teaching. For programs with a sincere interest in diversifying student populations, however, and with an interest in retaining those students who are prey to the “leaky pipeline”, teaching practices comprise one piece of the multivariate solution.^{23,24}

At present, teaching practices are of central interest to a niche group of engineering educators including, for example, presenters at conferences such as the *American Society for Engineering Educator (ASEE) Annual Conference* and the *Frontiers in Education (FIE) Conference*. Since poor teaching by engineering faculty has been shown to be a contributing factor to student attrition from engineering, studying the beliefs and practices of faculty who are committed to teaching may provide ideas of how to improve engineering education in general. Our study sets out to explore which practices are viewed as most effective by those engineering faculty with high levels of interest in cutting-edge teaching.

4. Methodology

Attendees at *Frontiers in Education (FIE)* conferences include a unique population of engineering educators who have a demonstrated interest in pedagogy, probably beyond that of the typical engineering faculty member who is focused on technical research. Thus this population affords a rich source of data to begin to answer the research questions of what engineering educators believe are effective teaching practices. Using the list of presenters attending the 2006 FIE Conference, we emailed all attendees requesting participants for a study on “effective teaching practices.” To qualify for the IRB-approved study, participants were limited to faculty with engineering degrees who are currently tenured or in tenure track positions at four-year institutions in the U.S. or Canada. Respondents signed up for interview slots.²⁵ In sum, 26 engineering educators were interviewed using open ended, structured and unstructured qualitative questions which sought to measure their beliefs and practices about effective teaching. Finally, the participants completed a demographic information form and answered other qualitative questions about their educational backgrounds. The findings from this pilot are not generalizable to all engineering educators because probability sampling techniques were not used, and were not conducive to the qualitative nature of the project. A smaller sample size is typical of ethnographic research, which seeks to yield abundant, rich, in-depth information about a particular community.²⁶

The participants in our study came from a variety of engineering disciplines including chemical, electrical, industrial, mechanical, and computer science. They are employed at a range of

institutions including public and private, small and large colleges and universities. As shown in Table 2, the average age of the participants was 50 years with an average of 20.5 years of college level teaching experience.²⁷ Our sample included 18 men and 8 women which correspond to about 70% male and 30% female. Note that women are overrepresented compared to national average, however, FIE tends to include more women engineering professors than a typical engineering conference.

Table 2 Descriptive Statistics for Participants (N=26)

	Minimum	Maximum	Mean	Std. Deviation
Age (years)	30.00	67.00	50.28	9.75
Number of years teaching	3.00	45.00	20.52	11.12

The participants in our study did indeed show a commitment to teaching. This is evidenced by their generally spending more energy on teaching rather than research despite being rewarded more for research as shown in Figure 1. For example, of the sixteen respondents who reported being rewarded more for research, ten of them reported spending more energy on teaching. Participants reported regularly attending conferences such as FIE and ASEE (85%), having attended workshops on teaching on their campuses (89%), and reading articles about pedagogy (often or somewhat often, 82%).

Figure 1

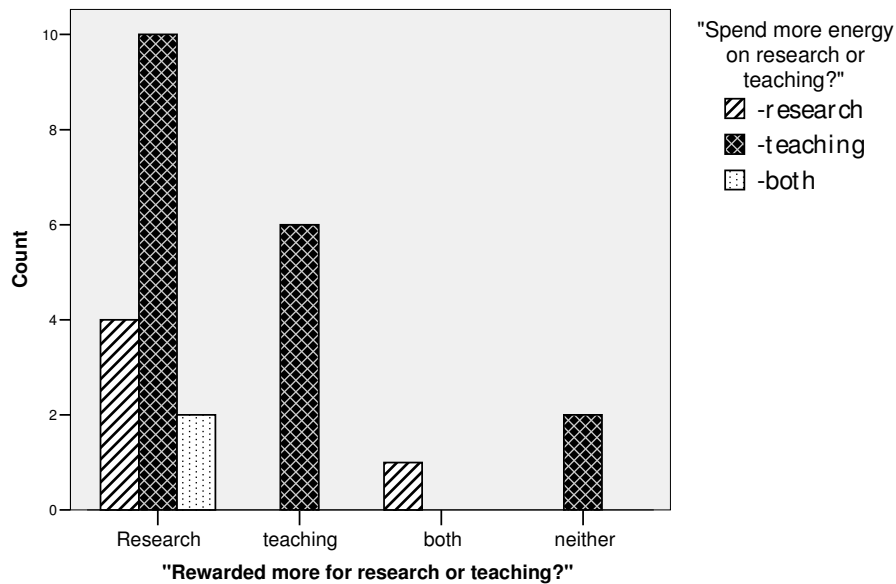


Figure 1 Overview of participants showing where they spend their energy (teaching or research) and what they are rewarded for. (N=26 Source: FIE 06 Self-selected respondents)

Finally, although we did not utilize a quota sample to stratify engineering educators by whether or not they identified as “feminist”, Figure 2 indicates that some were (n=11), and these included both men and women. Note that we classified four participants as “neutral.” These respondents did not specifically answer “yes” or “no” to “do you identify as a feminist?” When analyzed, however, their qualitative answers typically indicated an open-ness to the ideas of feminism.

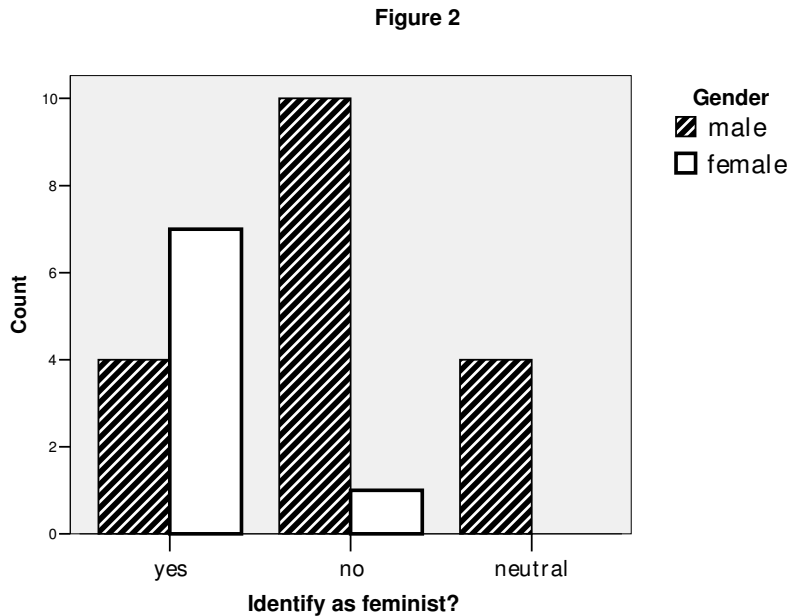


Figure 2 Overview of participants who identified as feminist broken down by gender (N=26 Source: FIE 06 Self-selected respondents)

5. Data Analysis and Discussion

Overall we found that there is significant overlap between how these engineering educators conceptualize effective teaching, and how feminist educators describe the same. Although there were a range of responses, our preliminary analysis shows that, among the engineering educators interviewed, very few rely solely on traditional methods of instruction, which include blackboard/whiteboard and PowerPoint methods. This is consistent with the topics of papers presented at FIE conferences. There are typically multiple sessions on active learning in the engineering classroom. There was, however, significant variation in terms of how professors discuss the issue of classroom climate. While tremendous emphasis and detailed thought is expended on the methods of enhancing learning, fewer place an explicit emphasis on student experiences. Below are excerpts from the interviews, grouped by theme, analyzed and compared with the literature in feminist pedagogy.

Few engineers expressed the sentiments conveyed by this male professor who has been teaching for over forty years:

the problem I am seeing right now in the students is the lack of discipline. As I tell my students, I've taught them, I've taught their parents, I've taught ...some of their grandparents...society has changed. Now it appears to be students are being given a lot more, they don't have to work for as much, they expect a lot more. And, as such, when they come into the classroom they really don't have the study regiment that they need. They don't understand what is really needed to be able to learn... so the techniques I am using: I would usually lecture on a chapter in the text book, and the following periods would be utilized to ... do nothing but work problems with a lot of the pressure on them to provide the leadership and the problem solution.

Here we do not see a sense that students are partners in the learning process. Rather, this exemplifies the quintessential "professor as authority" role. By contrast, in the following example, the professor demonstrates some self-awareness; his is not a rigid class environment, he allows some discussion among students:

I try to involve the students in quite a bit of what I'm doing. You can read on their faces what they're puzzled about. I'm delighted when I see a student lean and point to the board and say something to another student because that means they're questioning what's happening especially maybe the numbers on the board. And then the other person is explaining maybe why that's right or if I made a mistake why that's not right.

Another echoes the importance of gauging student comprehension. This male professor says, "And certainly I would look for cues from the students in terms of them not paying attention or getting lost."

Some professors rely on lectures and PowerPoint, such as one female professor who uses overheads provided by a textbook. But she laments, "I get criticized from the students if I use them too much because then they'll say I'm just reading from the book, but what I'm really doing is explaining from those overheads". Others by contrast assert that these methods "are not as effective because they put you to sleep...It would be like going to a physician and he gives you like what's on page 17 (laughing) instead of actually checking your body and seeing what you really need. I think that either transparencies or the power point lecture are not a good way to do it because it loses the interaction." A scathing critique of this method was provided by this female feminist engineer, "lectures are the most efficient ... at getting students to mimic and swallow whole and regurgitate lumps of information that somebody has decided that they should learn in this authoritarian way."

One tenet of feminist pedagogy involves a rejection of the "open and pour" method of teaching. As one of our female engineers describes, students are partners in the learning process.

my pedagogical model might be about effectively trying to empower the student to the position of equal learner with teacher rather than an efficient model about transmission of knowledge...

Some engineering educators were somewhere between the professor as expert or “sage on stage” and professor as equal partner with students in the learning process. The term “guide” was often used although it connoted different meanings for different participants.

I consider myself the expert here and with these teams I actually ask them to meet with me twice, all members present. I will give them advice not as the person [who is] going to grade the report but as a person who has seen a lot of reports over the years. ... And so I'm not really a guide. [male participant]

Another male participant described how he is an “expert guide”. Note that he is still maintaining control of the process but is eager for students to feel that they are an integral part.

They have to believe that the purpose of their being a student is for all of us to learn. And in order for them to learn they have to work with each other, in order for me to learn they have to work with each other. So for us to succeed, they need to be an active part of it ... They have to feel like they truly are an integral part of the process, they're not just a passive entity that comes for 50 minutes or an hour. They have to be an active part of it.

In order for me to lead, you have to want to follow me. I can go lead and if nobody wants to follow me or they don't see the sense in that, then it's not successful. But if they feel an integral part of that, then my role in helping that guiding makes a lot more sense. ... rather than an expert, I think you're an expert guide. In other words you have to use your expertise to guide the discovery. ...

One male participant describes his role in problem-based learning along this continuum.

you act more as a coach rather, and you let the problem drive the learning as opposed to giving the problem after the lecture to practice.

Professors who talked about their role as guide or coach were more likely to use active learning or problem-based learning in their classes. This shows that a shift in teaching practices goes along with a shift in how a professor views his or her role in the classroom.

An emphasis on rote instruction, without opportunities for discussion, constructs the professor as sole authority, thereby limiting interaction between professor and student and stifling possibilities for comments and critique. This teaching practice of lecture-alone is not only boring; it minimizes the exciting synergy that can ensue when students feel that they are co-contributors to the process of academic inquiry. As one of the feminist engineers who began her career lecturing, commented “[I lectured] because that's what everyone else did”; however, she “didn't understand why it felt so uncomfortable to stand in front 180 males and 5 females, blabbing ... for an hour.” After attending a workshop on teaching engineering, she concluded that, “lectures were a poor form of teaching” particularly for those professors who are not very good “performing artists” or entertainers who could capture the interest of the students. She concludes, “...for the majority of engineering professors who have not been trained in public speaking... well they should really try something else.”

This sarcastic view could be suggestive not only of what may be a constant challenge of having to forge against mainstream modes of teaching, but perhaps also an exasperated tone for someone who is at the cutting-edge, but also on the fringe of mainstream engineering. As a side note, this female engineer also noted, “I’m always getting attacked on that issue by people who are very protective of their lecturing.”

A male engineering professor, who prefers active learning to lectures, is also highly conscious of how his teaching strategies might have a direct impact on attrition rates. He says,

I didn’t do this at the beginning; it took me, oh, probably ten years... You know, you did what you were taught, and if you made it through you were a ‘survivor’ --that meant that it probably worked for you. But it didn’t work for other people who didn’t make it –they were filtered out, unfortunately in many cases.

This quote illustrates how teaching methods might be correlated to retention. His use of the metaphor, “survivor”, evokes the familiar “sink-or-swim” image often used to characterize engineering education. Clearly, industry values collaborative teamwork, and yet many current modes of teaching continue to prioritize an individualist approach to transmitting information, as if it were a “one-way” endeavor. Some engineers challenge this trend. As this male professor notes, “I always try to build a sense of community in the classroom because in a team design project you have to have a sense of community ... our design project is service learning so we’ve got to feel that we are part of a whole.” Others describe the importance of learning and using students’ names in class. This could be tied to creating a more welcoming classroom, sense of community, and valuing of the individual.

One feminist engineer makes explicit how her teaching strategies have been directly impacted by feminist approaches:

I’ve been really influenced by liberative pedagogies. And my main goal is to empower students. That means helping them both think critically and act reflectively based on what they’re learning. My teaching techniques revolve around that and so on a typical day I am facilitating student learning rather than downloading information ... to them. So that means they come in prepared, that means they have to do the reading. I generally will have some questions to review things that were in the reading that they did. And then we will move into the problem solving sessions, which are done both collectively and individually and in small groups. I try to mix that up ...if it’s a new problem we’ll do it in the large group first, and then they might [work] alone or together in pairs, or in small groups. I do discussion in my classes frequently, which is probably unusual for engineering classes, but discussion can come up in a variety of ways sometimes that relate to ethics because I incorporate ethics in all of my classes.

Whereas some professors believe discussion is not suitable to engineering courses, such as one male professor who suggests that in engineering there is a “black and white, so-called truth...” and, to paraphrase, “a bridge that failed is always going to fail regardless of student voice”, other professors seek creative opportunities to incorporate discussions. Perhaps some participants are motivated by ABET requirements to incorporate ideas such as ethics, teamwork, and

communication to change how they teach and include more student discussion. Still others are even more radical in their approaches to teaching. Two female feminist professors, for example, suggest that substantive nature of course material represents a series of *choices*. A syllabus, for example, represents a set of choices made by the professor. A textbook on thermodynamics reflects a set of choices by the author to incorporate fossil-fuel cases as representations of energy, to the exclusion of other cases (such as wind-power). There are, as scholars such as Michel Foucault²⁸ have asserted, subjective realities that affect who constructs truth, and power relations that filter how it is presented. By empowering students to share the information, of how for example the canon of thermodynamics is established, students are also empowered to consider future possibilities to change the canon. In viewing teaching as a possibility for negotiating knowledge, rich and creative possibilities for potential student contributions can blossom, evolve and thrive.

6. Conclusions: Why Pedagogy Matters

As shown in this paper, there is overlap in the ways that feminist practitioners and theorists describe effective teaching with that of a sample of engineering educators. There was a good deal of consensus on the idea that effective teaching goes beyond traditional lecturing. Although there may be a tendency to assume that the content of engineering precludes the use of alternative pedagogical practices, our findings show that is a misconception. Some of the participants in our study had a great deal in common with feminist pedagogy stances. Feminists and engineers differed most notably on their levels of reflection on the concept of the power dynamics in the classroom. While the engineering educators who participated in this pilot study are among those who are the most interested in innovative pedagogies, they tend to focus more on specific techniques to enhance student learning. Fewer explicitly addressed the issue of empowering students.

Future research would do well to examine why diversified teaching practices are not encouraged and supported within the wider engineering community. What precludes other engineering educators from becoming interested in pedagogy? Clearly, in some cases it is because they are not rewarded at the institutional level. Also, there is not a climate among engineers in general that promotes diverse teaching methods outside of the group who attend these education conferences. Perhaps there is an engineering culture that favors mainstream approaches to the exclusion of alternative pedagogies. This could be due to resistance to change, unlikelihood of challenging authority, excessive devotion to tradition or perceived rigidity of the discipline.

Some engineering educators may not see a direct link between alternative pedagogies and innovative technical ideas or improved climate. As one of our female feminist engineering professors explains,

I think ...engineers, when they sit down to teach a course or write a textbook, are writing what they were taught. And so there's something, there's a precedence effect where you are just sort of doing what was taught because that's what it is and because we don't talk about the canon in engineering. ... Every other discipline talks about ... 'What are the classic texts? What are the key things that you need to know?' Even though we have accreditation and we have ... some discussions about what constitutes a good engineer,

it's very skill-focused. And we haven't really asked some of the questions that we should be asking. What do engineers need to know now? What do we need to know in order to plan the future? And to recognize that the choices that we are making have an impact on what kinds of technology are going to be available in twenty years.

These are radical ideas in engineering education. While it is not typical to challenge the canon, perhaps by injecting new ways of thinking about modes of teaching/learning, creative responses will arise to meet contemporary engineering challenges. By better understanding these factors, we can begin to make engineering a more welcoming place for a greater variety of students. Such a dynamic can only be achieved by invigorating the way that the engineering canon is currently conceptualized, disseminated and shared.

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