

Pathways of Feminist Engineering Education Scholars

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BACKGROUND

Engineering education has emerged as a field, or perhaps even a discipline, worthy of study in its own right. While other scholars have discussed the history of the field as a whole, there remain many more specific facets, such as feminist communities, left to examine. Furthermore, recent engineering education scholarship suggests that the stories of engineering educators - which reveal their motivations and pathways - are important because they provide insights into the rationales, motivations, and decisions that guide research and career decisions, as well as knowledge about processes of getting started in engineering education research. In addition to the implications this work has for the larger community of engineering education researchers, it also has implications for diversity, recruitment, and retention within engineering because feminist engineering educators and researchers work to create more just, less gender-biased, learning environments. Therefore, research that provides insights on how to broaden the community of feminist engineering educators has the potential to contribute to more just learning environments, which could in turn increase diversity and improve recruitment and retention efforts.

PURPOSE

The purpose of this paper is two-fold: 1) to provide a new piece of the history of engineering education as a field by identifying pathways of feminist educators, and 2) to contribute to the body of scholarship on the history and development of feminist thought across and within various fields.

DESIGN/METHOD

Semi-structured interviews were conducted with fifteen Australian and US engineering educators and engineering education scholars who were identified primarily through their involvement in feminist engineering education initiatives. Among other questions, participants were asked how they became involved and interested in feminist initiatives.

RESULTS

Pathways leading to involvement in a feminist engineering education initiative were varied, but common experiences across participants emerged. Participants traced their involvement and interest back to many different types of experiences, including: negative experiences in engineering and engineering education settings, coursework in women's studies, involvement in women's groups, and design workshops.

CONCLUSIONS

Some current strategies, such as workshops and conference sessions, have proven effective at promoting interest in feminism in engineering education, and others, such as social science coursework and training to look for gendered facets in data, should be further encouraged. The challenge of broadening the community when colleagues have been trained to believe in engineering's gender neutrality deserves further attention.

KEYWORDS

history of engineering education, faculty, feminism

Introduction

Engineering education has emerged as a field, or perhaps even a discipline, worthy of study in its own right (Adams, Allendoerfer, et al., 2007; Borrego & Bernhard, 2011; Jesiek, Borrego, Beddoes, et al., 2010; Jesiek, Newswander, & Borrego, 2009). While other scholars have discussed the history of the field as a whole (Borrego, 2007; Borrego & Bernhard, 2011; Borrego, Streveler, Chism, Smith, & Miller, 2006; Jamieson & Lohmann, 2009; Jesiek, Borrego, & Beddoes, 2010; Jesiek, et al., 2009), there remain many more specific facets left to examine. For example, very little research has yet focused specifically on those involved in feminist engineering education initiatives. Therefore, one purpose of this paper is to provide a new piece of the history of engineering education as a field. Another purpose is to contribute to the body of scholarship on the history and development of feminist thought across and within various fields (e.g., MacNabb, Cherry, Popham, & Prys, 2001; Paludi & Steuernagel, 1990; Schiebinger, 2001; Spender, 1981; Stacey & Thorne, 1985; Stanton & Stewart, 1998; Strathern, 1987).

Recent engineering education scholarship suggests that the stories of engineering educators that reveal their motivations and pathways are important (Adams, Allendoerfer, et al., 2007; Adams, Fleming, & Smith, 2007; Allendoerfer, Adams, Bell, Fleming, & Leifer, 2007; Downey & Beddoes, 2011). For example, building upon strong traditions of storytelling and oral history methodologies (Gluck & Patai, 1991) in many other social science and humanities fields, Adams and colleagues contend that storytelling can help us: understand identity pathways and identity formation; illuminate histories that have been hidden or ignored; identify the ideas that define a community; gain entry points for understanding a community of practice; empathise with others and learn where they came from; and understand new perspectives (Adams, Allendoerfer, et al., 2007). Furthermore, they argue, personal narratives have distinct benefits over traditional presentations and publications because they provide deeper insights into the rationales, motivations, and decisions that guide research and career decisions, as well as knowledge about processes of getting started in engineering education research. All of this, they suggest, is important for advancing the field of engineering education research. This paper builds upon the work of Adams et al. and upon other recent work exploring engineering educators' motivations and pathways (e.g., Downey & Beddoes, 2011). It employs the stories of an understudied group of engineering educators and researchers to advance knowledge about the field of engineering education and contribute to those ends identified by Adams et al. above.

Specifically, this paper addresses the following questions: How and why did participants become interested and involved with feminist engineering education initiatives, and what can their pathways tell us about expanding the community of feminist engineering educators? In addition to the implications this work has for the larger community of engineering education researchers, it also has implications for diversity, recruitment, and retention within engineering. It is widely noted that women remain underrepresented in engineering in the United States and Australia (Mills, 2011; Mills, Mehrtens, Smith, & Adams, 2008; National Science Foundation Division of Science Resources Statistics, 2011) and gender biases and discrimination against women on many fronts have been amply documented (Bell, Spencer, Iserman, & Logel, 2003; Dryburgh, 1999; Du, 2006; Gill, Sharp, Mills, & Franzway, 2008; Godfrey, 2003; Jolly, 2007; Mills, et al., 2008; Roberts & Ayre, 2002; Stonyer, 2002; Tonso, 2007; Wolfe & Powell, 2009). Feminist engineering educators and researchers work to create more just, less gender-biased, learning environments that address a range of discriminatory practices. Therefore, research that provides insights on how to increase the number of feminist engineering educators has the potential to contribute to more just learning environments for all, which could in turn increase diversity and improve recruitment and retention efforts. Moreover, feminist pedagogies can benefit *all* students, not just women (Waller, 2005a).

The paper begins with a brief overview of feminist engineering education initiatives as part of the larger field of engineering education. After a description of the research methods, the pathways that led participants to involvement in feminist engineering education initiatives are described. Following that is a discussion of implications the findings have for both engineering education as a whole and feminist engineering education more specifically. The paper concludes with plans for future work.

Background on Feminist Engineering Education Initiatives

As discussed elsewhere (Beddoes & Borrego, 2011; Beddoes, 2012), engineering education research on women and gender emerged as a notable body of work in the 1980s and has remained a small but important part of engineering education ever since. While most of that scholarship concerned with women or gender could be labelled “feminist” by some interpretations of that term, that scholarship by and large has not engaged feminist theories, used the word “feminist,” or recognized “gender” as a social complex social hierarchy (Beddoes & Borrego, 2011; Godfrey, 2003; Pawley, 2007; Riley, Pawley, Tucker, & Catalano, 2009). It has been argued that the lack of engagement with feminist theory is a problem because the assumptions built into much engineering education research on women perpetuate the status quo by leaving gendered facets of the culture itself unchallenged (Beddoes & Borrego, 2011).

However, there have recently been efforts by small pockets of engineering education researchers to advance explicitly feminist research and pedagogy. In general, these efforts differ from the vast majority of scholarship on women in engineering by advocating greater engagement with a wider range of feminist thought outside the liberal tradition, by critiquing assumptions built into much current research, and by focusing on gender as a social construct rather than as simply a male/female dichotomy. In the United States, beginning in 2004, there have been papers and special sessions on feminist research and pedagogy at the annual Frontiers in Education (FIE) Conference (Eschenbach, Cashman, Waller, & Lord, 2005; Lord, Cashman, Eschenbach, & Waller, 2005; Lord, Eschenbach, Waller, & Cashman, 2004; Pawley, Riley, Lord, & Harding, 2009; Riley, Catalano, Pawley, & Tucker, 2007; Tucker, Pawley, Riley, & Catalano, 2008; Waller, 2005a, 2005b). There have also been recent journal articles on *feminisms in engineering education* and *feminist engineering* (Riley, 2008; Udén, 2009). Two other papers advocating greater engagement with a broader range of gender and feminist theories have been published in engineering education outlets (Beddoes & Borrego, 2011; Nelson & Pawley, 2010). Additionally, in both the US and Australia there are now feminist engineering research groups (Mills, Gill, Sharp, & Franzway, 2011; Pawley, 2012).

Methods

Participants were 15 educators and researchers, 10 US-based and 5 Australia-based. They were primarily identified through their affiliation with self-labelled “feminist” engineering education initiatives, including publications, research groups, and conference sessions. Two interviewees were included after being recommended by an originally identified participant. Institutional Review Board (IRB) ethics approval was obtained, and potential interviewees were contacted by email. Participants included current and former faculty/staff and represented all academic career stages. They had graduate degrees in anthropology, economics, education, engineering, math, psychology, and sociology. At the time of the interviews, 11 worked in engineering or engineering education departments, 1 in sociology, 1 in economics, and 2 were former faculty members turned independent educational consultants. Given the small pool of scholars who have been involved in “feminist” engineering education initiatives, providing further demographic details could risk participants’ anonymity and has thus been avoided. The aim of including both Australian and US participants was not specifically to compare the two countries but rather to provide an international perspective.

The semi-structured interviews were conducted between April 2009 and December 2010, and lasted between 15 and 83 minutes, with an average length of 49 minutes. Three were conducted in person at engineering education conferences and 12 were conducted via telephone or Skype. I recorded and transcribed the interviews verbatim. Transcripts were later edited to remove false starts and language such as: “um” and “you know.” Each participant was assigned a pseudonym for this paper. Prior to submission for peer review, all participants had the opportunity to review and comment on this paper.

The interviews covered a wide range of topics, and findings based upon different aspects of the data have been published elsewhere (Beddoes, 2011, 2012). The question that forms the basis for this analysis was: *Can you tell me how you became interested in or involved with feminist engineering education initiatives?* I quote at length in this paper in order to allow the richness of participants’ stories to emerge in their own words.

Findings: Varied Pathways

Participants traced their involvement in feminist engineering education projects to many different types of experiences, and most described more than one motivating experience. They included: negative experiences in academic engineering settings (n=5); coursework (n=5); involvement in a women’s group (n=4); negative experiences in non-academic engineering workplaces (n=3); FIE conference sessions (n=3); social science backgrounds with a focus on gender (n=3); reading the work of other feminist engineering educators (n=3); attending a design workshop on gendered design (n=2); emerging through data or research on another field (n=2); and having daughters (n=1).

Five participants attributed their interest to a negative experience they had in academic settings, as undergraduate and graduate students in engineering programs and as engineering faculty. Kate attended a college that was still wrestling with co-ed integration where “there was a lot of hostility toward women on campus” which influenced the context in which she was learning engineering. Nancy had a similar experience as an undergraduate and negative experiences as a graduate student and engineering faculty member as well:

For me it’s been going on since I was an undergraduate. When I was an undergraduate... there were enough women to threaten the men, they could no longer be ignored like the first set of women were. But then by the time I got there men actually found the women a threat and therefore started pushing back...and then when I actually started my own career I was the only woman in the department at [a different university] who was a faculty member. And I realized very quickly that in order to be heard at the faculty meetings I had to stop talking the way that I usually talk and make sure that I talked as the men talked so that my ideas would be heard and attributed to me rather than picked up by somebody else.

Amy described a negative experience with a particular professor:

My junior year [in] one of my electrical engineering courses I had a faculty member who was just a jerk. I mean there’s really no other way to say it...who routinely made jokes in class about women and about people of colour...And I went to his office one time to ask for help on a homework problem and I opened up the book to where the question was and he closed the book on me and said that he wouldn’t answer my question. And then I asked him something about the lecture that day and he said something about the double stub tuner and I said “Oh, ok, thank you, I think I understand that now.” And he goes, “That’s ok. I understand. I have a wife. I have a daughter. Girls have these kinds of problems.” And I’m still thinking about the double stub tuner, so it actually took me a while to respond. I couldn’t even make the connection. I had no idea what my gender had to do with the double stub tuner. I still don’t know what it had to do with it. But I was really shocked. [Be]cause I didn’t think people thought this, and I didn’t think people voiced it. I thought at least if you thought it, you were smart enough not to say it. And I was just dumbstruck. I didn’t know what to say. So I decided then that SWE [Society of Women Engineers] would become more political and we would have some talks by women and gender studies, [be]cause I didn’t want anybody else to feel as powerless as I felt at that moment.

Jane described a general feeling of not belonging: "I didn't feel like I fit in. And I was certainly good academically, but I wasn't comfortable and it didn't seem like anybody wanted me there." This participant actually left engineering as an undergraduate and came back "by accident" in graduate school. Amy, Kate, and Maggie also described becoming aware, or having a startling realization, of being greatly outnumbered by men, which caused an uncomfortable feeling of not belonging or "sticking out like a sore thumb." Kate described realizing that she would never have another female professor.

Three other participants attributed their interest to a negative experience in a non-academic engineering workplace. Linda said of her experience at three different engineering jobs in the 1970s and 80's:

[E]very day I came in and every day I had an encounter with someone, whether it was a secretary, whether it was some person from the field, whether it was one of my engineering colleagues, whether it was a boss, you know whoever, the person who sent the drilling report out in the morning, the office manager, it didn't matter, I came into contact with somebody who said or acted in some way that indicated that I needed to prove yet again today that I was still an engineer. And you know this went on and on and on, it was just day after day after day of having to re-establish that I was an engineer. And it was very clear to me that the guys didn't have to do that...And you have to remember I entered engineering before it was illegal...to tell women that you didn't hire girls for your engineering jobs...I mean I couldn't find a job when I graduated because I walked into the interviews and they said, "Well, we don't hire girls."

Likewise, Sue also discussed discrimination when looking for a job:

[As] soon as I was applying for jobs in fourth year there was obvious discrimination where engineers who I knew had much lower marks than mine were having interviews and I wasn't even offered interviews with the same organizations and then [I] actually phoned the EO officer at one of the government organizations and instantly I was offered an interview and offered a job. And I asked for a day to see what it was like and I was told...I'm not to walk up the stairs...it was in workshops and they said not to walk up the stairs in a skirt because they'd look up my skirt and just to accept that the men behave like animals and just to accept that that is how it is and don't be surprised by that...so all around it just wasn't a very welcoming sort of place and I ended up not taking it.

Steve described an experience he had while in the military in the 1970s:

There...was a young engineer and she was trying to organize an activity highlighting women's contributions to the professions in the military and she encountered such incredible discrimination and harassment. That...was like an awakening. I didn't realize that there was a large segment of society for which engineering just didn't seem to have a place for. So since then I've always been sensitive to those individuals or groups...whose voices didn't seem to be heard too often or weren't included in many conversations.

Participants also traced their interest back to coursework they undertook in graduate school that furthered their knowledge of and interest in gender and engineering. Nancy pursued a doctorate in educational research methodologies, taking courses that included feminist research methodologies. She had also done a minor in math and science education while in graduate school and been exposed to gender differences in communication and teamwork there. Amy took a feminist studies class in graduate school. Explaining her reasons, she said:

I kept being asked what half the human race thought, you know, "What do girls think about this? What do women think about this?" Well I'm only really one person. I really don't feel appropriate representing half the human race. So I said I'm going to go take a feminist studies class, at least see what other people think. And when I went to take those classes...it was a whole 'nother world. Like, it had never occurred to me that people studied these sorts of things that they actually studied dynamics of gender or I didn't even know there were different kinds of feminism. So it was fascinating.

Similarly, Molly, at the encouragement of a friend, had taken a women's studies course in graduate school: "And then I discovered there were all these feminist critiques of science..."

Which really threw me into a tizzy because I thought, as an engineer how am I maintaining those structures of oppression and in fact devaluing women's perspectives historically and women's knowledge." Jane developed an interest in diversity and engineering classroom culture while working on a Teaching Assistant development program: there was a special session aimed at having people examine their own biases. Linda began to study gender in engineering in an ethnographic research methods course while pursuing a PhD in education.

Kate, Amy, Sue and Maggie also traced their interest back to prior involvement, including in some cases leadership roles, in women's group activities, as undergraduate and graduate students, and as faculty. These groups included both general women's activism groups on campus, as well as engineering-specific groups, including Society of Women Engineers and Women in Engineering (WIE) at both national and campus levels. Sue said that her involvement with a WIE group helped her to understand her own experiences as part of a systemic problem, rather than an individual one. The special sessions at Frontiers in Education cited above, and WIE Conferences were also motivating experiences for Sue, Amy, James and Kristy.

Kristy and Jane attended a National Science Foundation Project Kaleidoscope design workshop that was particularly influential for them (Association of American Colleges and Universities, 2011). Publications were another source of motivation for some. Molly described discovering the work of Donna Riley as influential and James attributed his involvement to the work of Donna Riley and Alice Pawley. For other participants, an interest in gender and engineering education emerged through originally un-related research. Sue noticed gendered facets of her data on another research project that led her to pursue research with a gender focus. James' interest also stemmed from his research in to another discipline, and gender-biased theories therein, which he saw having implications for engineering education. Sue also had an interdisciplinary experience that was influential: a colleague in the business department invited her to guest lectures where she learned about feminist scholarship in that field. Interestingly, Amy also attributed her involvement in part to having daughters "and thinking about what their life would be." Betty, an engineer, could not identify any particular experience that motivated her involvement. She said inclusive and liberative pedagogy had always just seemed "natural" to her. Bonnie, Mary, and Claire were social scientists who already had a gender focus to their research when they began studying engineers.

Discussion

Many different types of motivating experiences led interviewees to eventually become involved in a feminist engineering education initiative. Some of these experiences, for instance, the FIE sessions and Project Kaleidoscope workshop, provide evidence that those initiatives have had an impact and contributed to the development of feminism in engineering education. Others, such as coursework in women's studies, suggest that encouraging engineering students to take critical social science classes can promote the development of feminism in engineering education. The findings also reveal that participation in women in engineering groups can raise awareness about gender biases in engineering education. Additionally, it is worth highlighting the participant whose interest emerged from her data. Another participant, during a different part of the interview, said that researchers whose data has gender facets that they ignore - which she had observed among colleagues - contribute to the status quo as much as those who actively discriminate against women. This suggests, then, that future engineering education researchers need to be trained to not ignore gender in their data. For instance, if they observed differences in how men and women students experienced their engineering training, those differences should be discussed when the study results are published, rather than ignored or elided as gender-neutral experiences.

One significant issue raised by the findings concerns the role of negative experiences as motivators, and the implications that has for challenges to expanding the community. In other parts of the interviews, several participants discussed how challenging it can be to get

engineering colleagues to understand why feminism matters for engineering education, why they themselves are so passionate about such work, and why certain discriminatory experiences are so upsetting. The challenges they recounted are related to literature on the denial of sexism and belief in engineering's neutrality/objectivity (Beddoes, 2012; Mills & Gill, 2009; Riley, 2008). Furthermore, one participant who was a SWE advisor said she did not bring in feminist speakers or promote feminist discussions, unless students themselves initiated it, because she believed that students were not ready to engage in such discussions unless they had a negative experience and brought it up themselves. All of this suggests that despite the many possible mechanisms available, those who wish to broaden the community face the significant challenge of getting colleagues (who are trained to see engineering as neutral and objective) to understand feminist perspectives if they themselves have never perceived what they believe to be gender biases or discrimination. It is clear that negative experiences do not necessarily lead to feminist commitments, and it is clear that negative experiences are not necessary for the development of feminist commitments; however, given that over half of the participants reported a negative experience, it seems that this challenge warrants further consideration. At the very least, these stories provide further evidence that engineering education is not gender-neutral. It should also be noted that although some of the negative experiences occurred as early as the 1970s and 80s, more current research has demonstrated that such gender discrimination has not been eradicated (e.g., Tonso, 2007).

Future Work

There are several ways in which I plan to develop this work further. First, future analyses will discuss what participants believed was needed to expand the community and connect those findings to several bodies of relevant literature, including: communities of practice, faculty learning communities, and faculty motivations and decision-making. Second, the findings will be considered in light of the development of feminist communities within other disciplines, such as economics, which developed its own professional society, conference, and journal for feminist economists. Third, the findings need to be considered in relation to the many challenges of undertaking feminist projects in engineering education contexts, which I have described elsewhere (Beddoes, 2012). Finally, the pathways of non-engineers (such as 3 of my participants) who became involved in feminist engineering education initiatives deserve further attention in their own right, as engineering education continues to develop as an interdisciplinary field. This work also points to potentially useful topics of study for other researchers. For example, I focused on only one particular group of scholars, and similar studies on the motivations and pathways of a broader group of scholars who study women and gender would be useful. Studies on such scholars in other parts of the world would also be important in order to provide more international perspectives and to allow comparisons across national contexts.

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