Gender Equality in Software Engineering

Extended Abstract[†]

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ABSTRACT

This is the collected work of four female software engineers and myself. Their writing describes their lived experiences in software engineering and as mothers of children in school, while my own describes my lived experience of teaching computing to my children and their peers in school, and in clubs and community events outside of school. The four female engineers, who had the bandwidth to write at this time, include different levels of seniority and experience; an engineer who has come to software engineering late, after a non-computing education; and software engineers who have taken up leadership roles in project management. The views I express are based on my independent research as part of my self-funded PhD in Educational Research with the University of Cumbria. The author of the paper is identifiable as the male engineer, while the writing of the four female engineers is presented anonymously.

CCS CONCEPTS

KEYWORDS

ACM proceedings, text tagging

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1 INTRODUCTION

When the Call for Papers was passed to me, I was reminded of Fredick Douglass' words about speaking at the women's rights conference in 1848: Douglass was anxious about being asked to speak as a man at a women's conference, feeling that the male position in response to female experience should be one of attentive learning and support. He resolved his anxiety by noting that as a man who other men listen to, it was his responsibility to educate those men.

Therefore I put the CFP out to over 20 female industry contacts, all working in the software engineering field, together with an offer to write the piece for anyone who found personal writing difficult.

While speaking to the female engineers about their experiences both as engineers and as mothers with children in school, it was suggested that I also write of my experiences of teaching computing to my children and their peers in school, and in clubs and community events outside of school.

The four female engineers, who had the bandwidth to write at this time, include different levels of seniority and experience; an engineer who has come to software engineering late, after a non-computing education; and software engineers who have taken up leadership roles in project management. The writing of the female engineers is presented anonymously.

It is interesting to note that the writings leave out the formative influence of the software engineer's mothers. In conversations with two of the writers, the influence was clear, firstly, in teaching practical programming and providing relatable strategies for dealing with men in industry, and secondly, in reinforcing engineering as an important profession improving people's lives.

2 The Personal Stories

2.1 Project Manager

Although this response does not count as one of the stories of lived experience, I have included the response as it is indicative of the pressure of work in software engineering and the willingness of engineers to help:

"I just wanted to say that this is a great idea, and that if my project wasn't at a critical stage I'd be very interested in contributing – maybe next time. I hope it goes really well."

2.2 Software Engineer

I have worked in Software Engineering for the last 2.5 years, having previously completed a PhD and short post-doc in Astrophysics. I work on engineering projects for a large organisation in a medium sized office of around 60 people. With a background in Physics I am largely self-taught and have gained a lot of software knowledge on the job and from colleagues.

My experience of software engineering is that it has been incredibly friendly and inclusive. I have some flexibility in my working hours, the option of working from home occasionally and a good work life balance in general. I will be going on maternity

leave in a few months and so far have found my company to be very accommodating. I will be returning after a full year as I feel the company will provide enough flexibility for me to continue and I'm confident that I will come back to an equally challenging job that continues to stretch me and engage my brain. I feel software engineering is a good career to fit around starting a family, especially compared to my previous career in academia. However, there will be more challenges once I have a child to look after, for example for a few months a year overtime is (informally) expected and I'm not sure how I will be able to do that when I have a child to pick up from nursery at a set time.
I would say that it is noticeable how few technical women there are in our office and often I am aware that I am the only female in team meetings. Despite this, there are examples of women at all stages of their careers in our office which means there are always others I can talk to or ask for more formal mentoring from.
I think I am internally biased about myself in that I am quick to assume I've done it wrong or broken the code when there is probably an equal chance that any one of us made a mistake. I have had no experience of anyone else questioning my ability or commitment, but I wonder if it will hold me back in the future unless I am more confident in my own abilities. This may be because I have little formal training in software engineering so often lack the correct terminology to talk confidently about the code.
A career in software engineering was not something I was aware of growing up as my parents and family didn't know anything about it and it wasn't talked about at school. So it was only when I was at university that I fully understood what software engineering entailed and that it might be something that would suit my skills and abilities. I'm sure that if teenagers were more aware of software engineering and the problem solving and creativity skills that it requires, then more highly competent women and men would enter the industry.

2.3 Project Manager

I have worked at my present company for 15 years, first as a software engineer and now as a project manager. I moved into project management from computer science because I had an aptitude for it and wasn't excelling as a software engineer. My career was slow start with a secondment to safety engineering for 2 years before returning to a software engineering role.
I had a lot of support when I was younger for learning computing; the computer science teacher at school liked me because I was the top student in his computing classes, achieving top marks in the UK for one module. My mother has never understood what I do as her only experience is of home computing. My father was an engineer, managing the facilities at the hospital. Practical engineering, making people's lives better, was part of my life.
My grades on entering University were good, and many girls I know with similar grades chose more prestigious jobs like medicine. After gaining my place at university I was told I would have been accepted with lower grades if necessary as they "needed" girls on the course.
At university I was one of only 3 girls on my computer science course (a handful more did computer science and maths), and I found that many of the things that I had struggled with in school made sense by studying them as computer science. For example, I am dyslexic and struggle with reading, writing and listening to people speak. English Grammar really made sense when I learned it as computational linguistics.
At one of my placement interviews, an engineer asked if trampolining was really one of my hobbies, as listed on my CV and then asked if I would give a demonstration!
As I had graduated from a BCS accredited computer science course, I also looked into the BCS for career progression but it supported vertical progression to Chartered Engineer rather than my broad qualities I had gained during my career. Working part time as a project manager has been difficult at times and I have considered switching back to software engineering, however, I feel the advances in the industry since I was last an active software engineer makes the move difficult.

2.4 Senior Architect

Software Engineering is definitely a discipline in which women are underrepresented. To me as a woman in the industry there feels like no good reason why women should find it harder than men to enter this industry, the skills of a software engineer range from logical thinking, diligence, creativity and problem solving. As I look across my experiences in this industry, I don't see any real barriers other than one of perception. If more women believed they could be software engineers then there would be more young women entering the industry from school and university and the proportion of women engineers all the way through the industry would increase. I guess my question is why the low entry into the industry. Perhaps looking at how I got into software engineering would provide some clues.
I've been in the industry about 30 years now, why did I choose this industry? I went to a single sex school and was one of two daughters so I grew up oblivious to some of the social prejudices that girls experience in school – I enjoyed science and maths so these were natural choices. At university it was certainly different, I read maths and only 10% of my cohort were women, we are talking 30 years ago - and I believe there has been some improvement at least in mathematics. So why did I choose software engineering? I guess in part it was an industry I was aware of, my father was a programming language designer and author but I didn't spend my youth obsessed with computers, in those days computers were rarer but also being a software engineer is not about being a software geek –sure some software engineers would be happy with that label but it is not a prerequisite for the industry that I joined. My first experience of programming was a summer job as a Fortran programmer when I was 18. I enjoyed the logic of writing software and went from a maths degree to a Masters and then Doctorate in Computation, I could have stayed in academia but enjoyed the team work I had experienced during summer jobs I also enjoy contributing to tangible products, being able to say "I built part of that" still makes me feel proud.

Is it hard being a women software engineer? Most of the time I have not had a problem – occasionally I have had encounters with individuals who have found it hard to accept me as a software engineer. Years ago, when working as the technical lead of a software team on a client site there was one individual who refused to speak to me because “I was a woman” and would only take instruction from the male project manager. How did I cope? I ignored the negative attitude and over time I won him over simply by demonstrating that I knew what I was doing and could do it well. But in general experiences have been fine and over the years I think it has become less of an issue. It’s hard to judge whether that is due to changing attitudes or my gaining experience and but I do feel that there is less prejudice amongst the younger generation. I know I set my personal bar high and this has helped me to succeed, I suspect I have worked harder to gain recognition than my male counterparts and I know I have become respected for my talent rather than due to being of an ambitious nature, I am also conscious that I was lucky to join my present employer where I have certainly been encouraged to use my talents to their full extent especially during the early stages of my career – often being dropped in at the deep end and finding I could swim and swim well. Do women underestimate themselves in general as software engineers? Quite possibly some do, I think I would have felt more courageous at times if I had had more female role models and possibly I may not have felt the constant need to prove myself (although that could just be my nature). At the end of the day if there were more young women entering the industry then I’m sure both women and the industry would benefit.

2.5 Senior Project Manager

When I initially considered whether I had anything to share on my experiences with gender inequality within Software Engineering my immediate thought was that, no matter what or where in life there was always some sort of inequality, and I decided that I didn't have anything of note to share. However, I thought about it more and realised that I would like to share what I've experienced. I've worked in the Software Engineering field for 16 years now, and in that time I've also raised a daughter and I would like to offer something on both of these points.

With regards my 16 years in the industry I have not observed systematic gender inequality and I do not recall experiencing overt gender inequality as a one-off situation. I do not know if this is the norm, or if I'm extremely lucky to work in an environment where men and woman are not defined by their sex. I have sometimes wondered if things I've had said to me, or heard said to other women, would have been said to another man, but I feel that to routinely dissect this could easily become a paranoia and I prefer to see the good in people so err on the side of caution.

During my career I have felt the need to request a pay increase as I felt that those on a similar grade, and some on lower grades, all men, seemed to be on more pay than me (I don’t know this for absolute certain). The company listened to me, we discussed the situation, and I was given a pay increase approximately in line with what I was requesting. I am grateful for the working environment that my company provides; fair; supportive; open to discussion; one that I believe recognizes and encourages the needs of each individual, be it women or man, to be given fair treatment.

With regards raising a daughter, there is a clear imbalance of the numbers of men vs women in software engineering, not only in my own company but at all the clients I have worked with. It's not difficult to see how this can happen when the education offering, even for the Millennial generation, is so misaligned with what the industry has to offer. Quite frankly, in my experience, it is abysmal. Perhaps the education sector does not understand what software engineering is and what they could offer to encourage more women towards it but classes that teach word, excel and powerpoint do not come close and are even sufficient to put both women and men off of wanting to work on software or computers. Until there are more women in the software engineering industry any gender inequalities are just made harder to redress and while many people jump careers mid-career, there are many coming out of the education sector that should be headed into our industry and unfortunately they aren't.

2.6 Systems and Software Engineer, male

As well as being an engineer, I also run after school clubs in three schools and another out of school at the weekend; I run badge events for cubs and scouts; mentor at hackathons; and run digital events in the community. Although focused around making things on a computer, I teach programming as digital story making to link into the literacy curriculum, and highlight the practical application of mathematics in making beautiful things.

As a parent of four children attending primary and secondary schools in Bath, it seems to me that gender differences in academic engagement is a solved problem: for example, the biological links to boys underperforming in literacy was quickly dismissed, and replaced with the need for a change in individual gender identity, a change in gender stereotypes for learning in parents and teachers to support early reading, and an identification of engaging materials.

In my view, teaching computing as a creative discipline provides an added dimension of active engagement in education by allowing students to be more expressive and to critically compare the opinions of authors against the online data that is accessible with only a few lines of code.

The difference between the boys’ and girls’ schools is obvious to see: the boys’ school embraces computing across the curriculum, allowing boys to make computing projects for history and geography; the sociology and psychology teachers are interested in projects utilizing online datasets; the school organizes technology open days, using school facilities and at company sites; and the headmaster asks computing questions of the boys in the dinner queue. Although the girls’ school uses my creative ‘Who Am I’ interactive JavaScript project for year 7s, it has none of the additional drive for computing across the curriculum, and links computing to the mathematics department, which is a minority interest in sixth form.

As a student, I was mentored by my father that engineering was a hard industry which the majority of the population would not understand. I didn't realize gender was an issue in technology until

I got to know a young computer scientist while teaching children to code creatively. Her description of her experiences sounded like a horror story in comparison to my upbringing and view of the tech industry.

While intelligent, creative, and giving up her free time to be involved in community projects and introduce children to the world of creative computing:

- The ICT teacher at school had told her she was the worst at computing; and there were 'more John's than women' on her BCS accredited Computer Science course.
- Her university placement at a blue chip company left her on the bench. Even though she developed a tool that has been rolled out across the country, her placement report described her work as adequate. During her final year at University, she was bullied by her male peers for being left on the bench during her placement.
- Her family thought her doing computing was a waste of time, while supporting her brother in his journey even though he was less competent and less committed to study, and attending a non-BCS-accredited course.
- In her first graduate role at a small technology company, the company took credit for her community project and reprimanded her for being contacted by a leading industry player after her work was showcased in a major publication
- Her second graduate role didn't mentor her; her line manager persistently harassed her and the company dismissed her while making use of her self-improvement projects as both marketing materials and as the technical basis of their community-based projects.
- She was the only woman in possibly 2000 men at a conference she had personally saved up to attend; she was propositioned on the first day by a man who subsequently ignored her when she naturally refused.

Based on her descriptions, the resounding question in my mind was how could I possibly foster a love of technology and encourage girls to go into such a hostile environment?

However, as a brother who saw his sisters brought down by the men they aligned themselves with, how could I not be motivated to do something about it?

I see a huge level of family and community support given to boys starting out on their learning journey and later in their early careers: boys are often bought to my computing clubs by parents who say their boys are naturals on computers, and it is exemplified in my mind by this vignette from a community event where a family of three generations of women were supporting the homeschooling of their boy, pushing him past his boredom and apathy in his first efforts with HTML and JavaScript to make an interactive emoji. The typical response to girls learning computing is 'they will do it if they want to'.

I believe this leads to an expectation of support in young men, and a lack of understanding that the women in our industry need a similar level of encouragement and support.

As a parent educator, I attempt to make children aware of their strengths and how they filter their lived experiences; I attempt to build resilience in them to hold on to their dreams in spite of how their peers and social groups treat them; and, most importantly perhaps, I tell them of the accomplishments of women in technology that are not included in the media or in their school textbooks. I especially teach the boys to behave well, to listen and to value the ideas of others.

3 RESULTS AND DISCUSSION

I am studying for a PhD in Educational Research, using the Living Educational Theory methodology to improve my practice both as an engineer and an educator of children learning computing technology.

Living Education Theory puts the relational 'I' central to the research; repeatedly questioning my education influence in myself, in my relationships, and in the groups I am part of, in an effort to identify my own lived values, and present evidence and an explanation that stands up to academic review that I am living them as authentically as possible.

My own writing presents evidence that I am living true to my values in supporting development in the workplace; in teaching creative programming in junior and secondary schools; and in promoting the educational value of creative programming to the adult structures that support their education.

The female writers present evidence in their own voices of common problems of working in a technical field but with the additional issues of being a female in a male dominated environment; they also express issues unique to themselves.

With all the current action for change in technology, I have hope for the future, and the personal experiences presented in this paper increase that hope.

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My work in schools, with the cub and scouts, and in the community is also self-funded.

Teach Programming CIC is a not-for-profit I set up to raise funds to buy equipment for teaching programming as a creative discipline.

All views are my own and not of any organization I am part of.

REFERENCES

None