It's about bits of Machines & Stuff": Why girls don't 'do' engineering

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***Abstract**: This paper draws upon part of the findings of an ethnographic study in which two seventeen year old girls were employed to interview their peer about engineering as a study and career choice. It argues that whilst girls do view engineering as being generally masculine in nature, other factors such as a lack of female role models and an emphasis on physics and maths act as barriers to young women entering the discipline. The paper concludes by noting that engineering has much to offer young women, the problem is, they simply don't know this is the case!*

Introduction

Despite numerous high profile campaigns to attract women into engineering, recent figures suggest that that only 6% of UK Engineers are female (Peacock, 2012). At the heart of this figure are arguments that girls and young women are not attracted to engineering as they perceive it to be dominated by white, middle class, middle-aged males (for further discussion see Davis, 1996; Thom, 2001; NAEng., 2007; Burke & Mattis, 2008; NSF, 2009; Hørby et al, 2009; Jackson, 2010). Taking into account previous studies which looked at the issues around gender and engineering (see for example Perusek, 2008; Beddoes, 2012) the researchers set out to investigate why young women do not appear to consider engineering as being a potential career option.

In seeking to investigate this issue, this paper draws upon the findings of a small ethnographic study in which two 17 year old female high school students were employed to interview their peers about their perceptions of engineering as a career and study choice. By employing 'girls to talk to girls' about engineering the paper authors used participatory research methodologies (Cornwall & Jewkes, 1995) to gain an in-depth insight into the issues.

Girls Into Engineering: Methodological Approach

Following an intensive two-day research methods training programme, the two young researchers, both of whom were still in High School, were given a free reign to develop a qualitative interview guide with which to explore the issues impacting young women's perceptions of engineering. University Ethical Approval & Parental Consent was obtained to employ the girls; both of whom were employed as paid Research Interns. Utilising a purposive sampling strategy, twenty young women age 16 and 17 years were interviewed. The interviews focused upon girls' perceptions of engineering both as a study choice at university and also as a career option. All of the interviewees were British with four describing themselves as being from a Black or Minority Ethnic Background (BME) and the rest defining themselves as White.

All the girls attended one of two City Centre High Schools, located about 4 miles apart, within the West Midlands Region of the UK. The first school (School 1) is a selective 'grammar' girls grammar school, the second school (School 2) a selective 'church' mixed gender school. Both schools are known locally as 'good' schools, with school 1 frequently topping national tables for academic achievement.

The interviews were recorded contemporaneously and transcribed by the young researchers. The data was then analysed initially by one of the paper authors who used a simple coding approach to thematically group into concepts. Following this a secondary, more in-depth analysis of the data was conducted by both paper authors who worked together using axial coding to identify and critique the relationships between the concepts and sub-concepts.

Findings

The findings discussed in this paper relate to the first two themes identified in the analysis; how girls define engineering and girls' perceptions of engineering as a career choice. These two themes are particularly relevant when considering the issues around gender and engineering as the findings reinforce earlier work about girls perceptions of engineering as being a male dominated profession yet point to the girls' dislike of maths and physics as being one of the reasons why this continues to be the case.

How girls define engineering

The first part of the interviews focused on how girls perceive and define engineering. For over half the girls, their initial response reflected a lack of awareness and insight – they simply hadn't thought about engineering before. This is best illustrated by Ellen's reply to the question:

> *I don't really know what engineering is but I think it's just trying to work out how things are made, doing the maths behind how buildings are made.*
>
> **Ellen. 17. School 2**

Despite an initial reluctance to express an opinion, all of the girls did, with encouragement, articulate a response, with replies fitting into two distinctive categories: Engineering is based on Maths and / or Science: Engineering is about making and designing things.

In defining engineering as being linked to maths and / or science, five of the girls provided a relatively simplistic description that captured the basic underpinnings of the discipline but failed to show any deeper understanding. Indeed, in many respects despite indicating that maths and physics are integral to engineering this group of girls appeared to hold a somewhat traditional view of the subject – a point that is clearly expressed by Sahar:

> *Engineering is machines and machinery. Maybe it links with physics, but I can't see how it might with chemistry. And I can't see how it does with biology.*
>
> **Sahar. 17. School 1**

Of the twenty young women interviewed only one articulated the 'abstract' nature of engineering linking it to maths but also giving some indication that she was aware of the high level of intellectual reasoning and cognitive skills and abilities needed to be an engineer (although she wasn't able to fully communicate this):

> *I think I'd say you need to be good at maths for it, have a good special awareness and be able to see things in your head before they are right in front of you".* **Becca. 17. School 1**

Perhaps not surprisingly, the most frequently voiced definition of engineering, expressed by fifteen of the twenty girls, linked it to 'designing and / or making things'. For twelve of the fifteen the concept of size was crucial, with engineering being used to describe designing or making 'big things':

> *It's designing and making stuff. Big things. There are people who make phones and people who make cosmetics, but that's not engineering. Without engineering we wouldn't have buildings, telephone boxes [ ] you have to make sure buildings won't fall down. Which is quite important.*
>
> **Jodie. 16. School 1.**

> *It's bulk industry. Engineering makes a lot of things like packaging for food, it preserves food. It cleans out water. So it's quite important really.*
>
> **Mel. 17. School 2.**

> *I always think of it as building things, like roller coasters… Like how they work and making sure they are working well. Because you need that link between science and the things people use every day. Engineering kind of interprets science and uses it to make things.* **Sonya. 16. School 1**

Only one of the fifteen described a safety element of engineering:

> *It's like designing something to make it better. And I think it's important because if, for example, we didn't get the curve on a roundabout right, then tall lorries would tip over… and drains would be overflowing…* **Roshni. 16. School 1.**

Another two, depicted engineering as making or designing things that are crucial to society:

> *Society would be incredibly different to how it is now without it, because engineers are needed for all aspects of society.*
>
> **Aysha. 17, School 1.**

> *Without it we wouldn't have half the things we have today as it provides us with a lot of things people take for granted.*
>
> **Tessa. 16. School 1**

Although all of the girls seemed to be aware that engineering plays a central role in society, the majority of them appeared not to fully understand what this role is. This is not completely unexpected given that 15 of the 20 readily agreed that they don't know what engineering is about or what engineers do, a point effectively made by Carmen:

> *I'm not sure what engineering is? I'd say it's physics based… Engineers do a lot of technology and stuff…*
>
> **Carmen. 17. School 1**

From considering how the girls defined engineering and the role it plays within society the interviews turned to the issues around engineering as a career.

Engineering as a Career Choice for Women.

Whilst the matter of gender did not figure in the girls' definitions of engineering, when asked to consider it as a potential career choice fifteen of the sample indicated that they thought engineering was a male-oriented occupation. For most of these, the issue was not that *they* thought that engineering was for men but rather that *society* viewed it as so:

> *I think that it is seen as a masculine subject. I do know a girl that does engineering but she is the only girl in her group at university. You could say that it is male dominated.*
>
> **Danni. 17. School 1.**

> *I do think it is very male dominated. I wouldn't say that girls can't do it… most girls our age don't really hear of it, they don't really want to get into it because of the men.*
>
> **Helen. 16. School 1.**

For six of the fifteen who identified engineering as a male dominated subjected, the issue was not about engineering *per se*, but was instead linked to its connection with science, physics and maths, all of which were generally perceived to be 'male oriented' subjects:

> *I think there is a stereotype that engineering is a masculine subject. But I think that this is because of the connection with physics which is a boys subject.*
>
> **Aysha. 17. School 1.**

> *I wouldn't say I felt I couldn't do engineering because I am a girl… But more boys seem to be interested in maths and science. I think engineering's just more appealing to them.*
>
> **Emily. 16. School 1**

The relationship between girls' perceptions of maths and their career choices have been previously explored by Riegle-Crumb et al., 2011 who found that girls are not influenced by their *ability* in Mathematics but are instead concerned with the fact that they do not *enjoy* the subject. Such a lack of enjoyment may be one factor determining the participants' reluctance to consider engineering as a career choice. Whilst discussing the girls' choice of potential careers one unexpected issue emerged relating to family members who were engineers. Five of the sample had at least one parent or family member who was an engineer, with three of those having two or more engineers in the family. Noticeably, only one girl had a mother who was an engineer.

Contrary to previous studies which have identified parental role models as being key to girls' decisions to study engineering (Fouad et al, 2010), those participants who had a family member who was engineer appeared not to have been influenced by this in their career choice. Indeed, despite being exposed to engineering at various times in their lives none of those with a familial link to engineering wished to pursue it as a career. The reasons for this were remarkably similar, related not only to individual choice but also to the girls' perceptions that engineering is a male dominated field:

> *I only know males that are engineers. I don't know any women despite my Dad being an engineer.*
>
> **Sahar. 17. School 2**

> *When I went to Mum's office there were about 3 women and 20 men.*
>
> **Jodie. 16. School 1.**

> *My Dad and Brother are engineers…there's a few women compared to the amount of men. It's not that women can't be engineers. I just don't think females find it an appealing subject, job or career***.**
>
> **Ellen. 17. School 2**

Given that five of the girls had been exposed to engineering and engineers throughout their lives this exposure was not enough to make them want to enter the discipline themselves. The reasons for this are undoubtedly complex but this small study suggests that even when the girls do have a strong role-model who is an engineer, and are exposed to engineering from a young age, the lack of women role-models does much to shape their perspectives. Because they don't 'see' any women engineers, they don't view it as a career for girls:

> *It's definitely masculine. I remember in Dad's place the only women there were the receptionists… I did think about engineering as a career, and I was very tempted to take maths and science at A level, but as I went through GCSEs I found out where my strengths were and I guess I realised it just wasn't for me.*
>
> **Tessa. 16. School 1.**

> *For a while I thought about becoming an engineer. When my Grandad used to talk to me about it… He sort of talked me out of it too, he said it was hard work but worth it. Then he mentioned physics, at which point I decided no.* **Jodie. 16. School 1.**

Like Jodie, half of the sample felt the link between physics and maths proved to be an added barrier to their even considering engineering as a career. This, combined with a lack of exposure to the discipline for the majority of girls and a scarcity of female role models, appeared to 'frame' their overall perception of engineering as being something that girls ' don't do'.

Discussion

This brief paper has given a short insight into two of the themes which emerged out of this ethnographic study. In considering the data relating to how girls conceptualise engineering and view it as a career choice two 'demographic' factors emerge. The first of these relates to the schools the girls attended. Looking at the interview transcripts overall it seems that the girls in School 1 are more articulate and 'worldly aware' than the girls in School 2 – particularly when it comes to discussing engineering. This may be reflective of the fact that School 1 is a Grammar School, accepting only the top 5% of the population into year 7. Also School 1 is a single gender, girls only School where science and maths are heavily promoted (although it seems engineering is not). The second notable demographic factor relates to ethnicity – in looking at the data as a whole, ethnicity did not appear to impact the girls' perceptions or answers at all. This may be reflective of the multi-cultural nature of the city where the study took place (where 20% of the population are of a non-white background). Despite their educational differences the girls' perspectives were remarkably similar. Unless they had a family member who was an engineer, they knew little or nothing of the discipline and had not considered it as an option for themselves.

In considering why the girls appeared to have little or no knowledge of, or real interest in, engineering, it is important to note that when asked to think about what engineering was, the majority articulated it from a functional or applied perspective. To them engineering was about 'making or designing things' or 'making things work'. That only two referred to the 'creative' nature of engineering leads to the suggestion that the discipline as a whole, and engineering schools in particular, have much to do to promote engineering to girls. The links with engineering and maths appear to act to discourage girls – perhaps an emphasis on the creative nature of engineering could do much to make the discipline more a more attractive option for young women?

Conclusion

In conclusion, the main issue to emerge out of this part of the study is the need to provide girls with a clear message about what engineering is and what engineers do. The connection that the girls made between engineering and physics and maths, whilst accurate, needs to be addressed, so that instead of being seen in negative terms, physics and maths are seen as positive choices which could lead to a wonderful career in engineering. The discipline has much to offer young women, the problem, as this study has shown, is that they simply don't know it…

> *I'm not going to lie, I don't know a lot about engineering… I think it's to do with inventing and structuring things? I'm not really sure… But we wouldn't have bridges or infrastructure without it, we would be limited…. It's part of our development.*
>
> **Danni. 17. School 1**

> *People take it for granted and it's overshadowed by the more caring jobs. Science at A level means 'medicine and dentistry' because we have more contact with these jobs. With engineering, we might have the final product, but we don't see how it is made. We don't see the engineering side of it.*
>
> **Kelly. 16. School 1.**

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