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A Study of Female Pupils' Perceptions of Engineering

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SUMMARY

Focus groups were carried out with female S5/S6 pupils (age 16 to 18 years) to test perceptions of Engineering as a career. Two key variables were compared; an individual's *score* in terms of the Scottish Index of Multiple Deprivation (SIMD), and whether or not an individual was studying Physics at Scottish Higher Level.

BACKGROUND

Despite great efforts in terms of engineering outreach in schools aimed specifically at girls from an early age, there has been little increase in the numbers of female students selecting to study Physics, Engineering and Computing subjects at Higher and A Level and University^[1]. Strong gendered influences apply when female schoolchildren choose their subjects for Highers or A Levels, both to pupils and parents^[2,3]. Additionally, there is a strong negative correlation between socio-economic background and choice of STEM subjects at the post-compulsory stage of education^[4]

STUDY AIMS

This study aimed to:

- Establish background information on female pupils subject and career choice in the area of Engineering;
- Test perceptions of Engineering; comparing those who chose Physics at Advanced (Higher) level and those who did not;
- Identify any areas of negativity and misconception;
- Make use of the findings to inform strategic change and ultimately attract more female candidates to UWS to study Engineering;
- Provide an empirical basis for the removal of Higher Physics as a pre-requisite qualification for studying Engineering^[5,6].

RATIONALE

The purpose of this research was to examine female pupils' perceptions of studying a degree in engineering. It also examined girls' views of the fact that both Higher level Physics and Maths are usually required to enter an Engineering Degree.

METHODOLOGICAL APPROACH

A number of focus groups, each comprising 4-6 female pupils at S5/S6 level were undertaken in 6 Scottish schools. Purposive sampling divided the focus groups according to whether the pupils had selected to study Physics at Higher level or not. The schools included in the sample represented a range of SIMD neighbourhood as shown in Table 1 below.

Table 1. Research Design representing range of SIMD neighbourhoods

	High % SIMD 20 School	Mid % SIMD 20 School	Low % SIMD 20 School	Total
Pupils TAKING Physics	1	1	1	3
Pupils NOT choosing Physics	1	1	1	3
Total	2	2	2	6

Each focus group lasted for around one hour, with each group commencing with a set of Projective Techniques (Appendix 1).

Questions were structured around the basic Communication Model AIDA (Awareness, Interest, Desire and Action).

Data was analysed using Thematic Analysis.

KEY FINDINGS

The findings may be summarised thus:

- Physics-choosers connected the subject with Maths, Engineering & Electricity;
- Those who had selected to study Physics often had a family member who was an Engineer;
- Those who had NOT taken Physics generally described Engineering using 'negative' terms including: *Difficult, Confusing, Hard*. They also described it using mathematical terms such as *Equations*;
- Those who had taken Physics tended to mention *Industry, Work, Labour and family members*;
- Those who had NOT taken physics tended to mention *Work, Manual, Relatives, Bridges and Planes*;

- The best thing about physics was felt to be *problem-solving, understanding, and experiments*, whereas the 'worst things' were *repetitive, confusing and memorising*;
- Pictures featuring a single professional male led to comments about *construction, blueprints, projects and architecture*;
- Picture featuring two males elicited responses on more manual aspects, such as *maintenance, factory work – and engineers*;
- The 'professional' female picture generated comments about *'looking at plans', construction and architecture*;
- The more practical picture of a female engineering elicited comments such as *fixing (circuits, electronics, electricity), technology, design and computers*;
- Perceptions of Science subjects, generally, were positive but Physics was viewed less positively, when compared with Biology and Chemistry;
- Physics was felt to be challenging – and linked to Maths: pupils believed if they did not have a strong Maths capability, they could not 'do' Physics. Comments included: *I don't like Maths and that's contained a LOT in Physics: Physics is for the 'good at Maths' pupils: You need to be REALLY smart – if somebody takes Physics, you know they're really clever*;
- Engineering elicited three broad responses: *connection to a relative who had this experience (either study or work): a notion that it involved 'heavy metal and machinery'* and was therefore of more interest to male pupils: An awareness that Engineering involves *a range of disciplines* (participants were uncertain as to what each type of Engineering involves, for example one young woman stated: *I don't know enough about it – there's different types of engineering and I don't know what they mean.*

DISCUSSION

Pupils in Scottish schools choose which to progress to in the third year of their study (S3) during the second year (S2). At this stage, National 4 qualifications can be gained. During the 3rd year (S3) further choices are made regarding what subjects will be taken at S4 for their National 5 qualifications. Post-compulsory qualifications (Scottish Highers) are taken in S5/S6.

There did not appear to be a demographic distinction based on the SIMD: some pupils were certain of their prospective career destination and degree course by the age of 11 or 12, S1 (medicine, vet studies, teaching):

"Even if I wasn't sure what I exactly wanted to do, I knew it would be in the science area – so I picked the ones I enjoyed doing and where I was getting best marks"

Whereas others were more ambivalent:

"I only really made up my mind right at the point when I was filling in the form!"

Having determined broad subject areas, additional influences were felt to be potential career progression; these included areas of capability and those subjects that they enjoyed:

"There's a sense of achievement when you get it right – it's a challenge and you did it!"

"I'm confident that I can do it and I'm satisfied when I do"

"It just interests me – I like it"

Gender-stereotypes were evident – and Physics, in particular, was referred to as 'more for boys':

"More for boys – engineering is their subject and they know more about it"

"Not for girls – more boys take it in this school"

Additionally, there was evidence of some out-of-date associations with Engineering and 'heavy engineering', which dominated the West of Scotland up until the 1980s; when asked what they knew about Engineering, the following aspects were noted, with even some of those who had chosen to take Physics beyond the compulsory stage making this (family) association:

Table 2. A Comparison of Girls Perceptions of Engineering depending on the study of Physics

Physics	Non-Physics
Predominantly Male: Dad & Grandpa engineers	Heavy metal and big machinery
Involved in everything	Manual job – not a graduate job
Don't know that much	All male pupils want to do it
	Inventing things, like bridges
	Need to focus hard – things can go wrong
	Mechanical, apprenticeship, manual work

It was also observed that irrespective of parents' educational background, parents had a strong influence and were heavily involved in their children's subject choice decision, with their focus being not only on what their children would enjoy but also the options that would benefit them in the future:

"They wanted me to do what I enjoy but also to cover all the bases"

"They were keen for me to make the right choice – keep my options open"

Those pupils who are the 'first in family' to attend university are less likely to be aware of Engineering as a university discipline. Pupils' siblings were also mentioned as influence, if a sibling had already chosen Engineering.

Pupils also described teachers as a positive influence and said that liked to hear the “back story” of their career choice and trajectory.

CONCLUSIONS & RECOMMENDATIONS

In conclusion, where entry criteria to Physics and Engineering degrees are changed, it will also be necessary to raise awareness amongst school pupils that they can choose their career path at a later stage. The promotion of Engineering to younger pupils is recommended, particularly before subject choices are made. Any outreach activities need to be positively linked to a future career in Engineering.

Finally, the students’ perceptions of Physics as being a “hard” subject when compared to other subjects also links to a recent study which found that in being advised to “choose their best subject” girls are steered away from Physics at the pre-Higher stage, and therefore away from a potential Engineering career^[7]

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