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It's not just for Boys

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Abstract: *Against an historical background of sexual inequality in the workplace engineering persists as a bastion of inequality in the 21st century. This research examines the perceptions of engineering of 86 students, who chose to study the new Level 2 Engineering Diploma at age 14. The students were based in the South West of Birmingham, close to the MG Rover Longbridge plant that closed in 2005. The results have been compared with the results of the EngineeringUK survey (EngineeringUK,2012) on perceptions of Engineering.*

The survey involved 5 schools – one all girls' school. Nearly a third of the students were girls. The study provides an insight into how these students acquired their perceptions of Engineering and provides clarity as to why they were attracted to join the programme at age 14. A key aspect of this study is to understand why these girls did choose and stay with the study of engineering, whilst most do not despite performing as well as boys in Maths and Science at GCSE level.

Informed by the outcomes of this study the paper identifies key areas where work can be done to change teachers, parents and pupils perceptions and enable more females to recognise the possibility of both studying and working in an engineering field.

Introduction

SET (Science, Engineering and Technology) occupations are vital to the future of the British economy but statistics for these occupations show a stark contrast in the gender gap in a social climate of supposed sexual equality. In 2003 only 5.3% of all working women were employed in SET occupations although they make up 45.1% of the entire workforce. Women make up 10.3% of all people working in SET occupations. Of these only 5.4% are engineering professionals with most women working in science based occupations (UKRC, 2010).

There is an upward trend. From 2003 – 2009 there has been an increase of 2% - when women comprised 12.3% of the SET workforce. However if this trend continues it still means that women will not reach 50% in this century (UKRC, 2010).

We have to look to the education system to see how this trend can be accelerated because as a nation we are seriously lagging behind the rest of Europe.

Education is the one area where, if the will is there, effective changes can be made to improve the perception of engineering in young people. The perception of engineering and how it is taught at school level is critical if the gender issue in SET, and in particular, the engineering sector is to be addressed.

So where was Engineering education in schools prior to the Engineering Diploma being introduced in 2008 at GCSE and A Level? The answer is – virtually non–existent. In an EngineeringUK (2012) survey of 856 students only 2% of students studied engineering at GCSE level (representing 4% boys to 1% girls) and only 1% studied engineering at A Level (representing 1% boys and 0% girls). Engineering as a subject has to be discounted and a wider look at Science, Technology, and Maths must be taken to see where the engineers are coming from and the gender trends in these subjects.

For the engineering sector we need to look at Maths and Physics. Maths is a compulsory subject at KS4 (ages 14-16) and girls narrowly outperform boys. At A level girls make up 40% of A Level Maths students and again girls outperform boys. Interestingly, The UK Engineering Brand Monitor survey

(EngineeringUK, 2012) in the 17-19 age group 50% of males perceived themselves to be numerate compared to only 37% of females.

Science is also a compulsory subject at KS4 but approximately two thirds of students are entered for a combined science course – studying three sciences in the time allocated for two GCSEs. It has been argued that this streamlined course is a poor preparation for the rigours of A Level. Of those doing single sciences more girls choose biology. Physics is the least favoured science subject for all students and only 40% are girls. The situation worsens at A Level with girls making up 40.6% of all Maths A level entries and only 22.2% of those entered for Physics A level. Analysis by the Department for Children, Schools and Families indicates that only 19% of students who do combined science at GSCE go on to study a science at A level compared to 45% of those who study single sciences (DCSF, 2009). However, girls are still outperforming boys in Maths and all science subjects.

The Context

The Engineering Diploma was a new qualification introduced in 2008. A consortium of five schools in the southwest of Birmingham chose to offer this programme with a major component Principal Learning taking place at a well-equipped City Learning Centre (CLC). The five schools consisted of one 11-18 comprehensive and four 11-16 comprehensive schools (of which one was a boys' school and one a girls' school). Teachers from each school and CLC staff were involved with the delivery. The course delivered was the Higher Engineering Diploma (equivalent to 5-7 GSCEs at grades A*-C).

After 2 years the 11-18 school also delivered the Advanced Diploma (equivalent to 3 A Levels). This was a new programme which lasted four years before subsequently going into decline because of government policy on qualification equivalencies. The unique aspect of the engineering diploma in Birmingham was the fact that it attracted much greater numbers of girls than the national norms as Table 1 shows. This study was conducted to ensure that the reasons for this are captured and understood more widely. Although girls are in the minority in the three cohorts studied the numbers are far greater than the national average of 7.7% (January 2010 figures from the Engineering Sector Skills Council –SEMTA).

Cohort	Total	Boys	Girls
08/09	31	21 (68%)	10 (32%)
09/10	31	24 (77%)	7 (23%)
10/11	23	16 (70%)	7 (30%)
Total of 3 cohorts	85	72%	28%

Table 1: Numbers and percentages of boys and girls on the Engineering Diploma

The aim of this paper is to understand why so many girls opted for this course and the impact the programme has had on their perception of engineering, future education and career choices?'

Methodology

To compare the perceptions of engineering and influences on subject choice with a wider national survey by Engineering UK (2012) an online survey and a semi structured focus group interview was designed. The age of the students required parental consent and, as the group size is relatively small, it was important to ensure confidentiality. Parents and learners responded positively to the study and the acquisition of email addresses was straightforward.

The online survey provided information to enable a direct comparison with some aspects of the EngineeringUK survey with some additional questions specific to the impact of the engineering diploma course. The survey allowed the responses to be differentiated by gender and the focus group provided detailed insights into their perceptions. The Interview guide approach, (Manion, Cohen and Lawrence, 2007), was used on which a series of questions were posed in an informal conversation scenario which allowed the girls to expand and discuss the issues. The destinations tracking will give information about immediate choices post diploma course and also longer term pathway choices.

Findings

So what influenced the girls to choose the engineering Diploma? How were the students selected?

In the first year of the programme the participants were selected by the Design and Technology teachers from the 5 schools. The staff selected those that they felt were suited to this mixed academic and practical course with an emphasis on team work and independent learning. In the schools the course was oversubscribed and students had to apply and were interviewed for places. This resulted in the course being perceived as a prestigious course in subsequent years.

Survey findings

All the students were asked about the impact of various people on their decision to study engineering. The results corresponded with the larger survey by EngineeringUK (2012) with the main influences being teachers and parents, although worryingly most teachers do not consider themselves qualified to give career advice (Munro and Elsom, 2000).

The survey also included a question about other influencing factors. Table 2 shows the percentage of students who selected “Significant impact” and “Quite a lot”.

	Media	School Literature	School options events	Visit to engineering department of a University together with promotional activities for the Diploma	Visit to the CLC where the Diploma was to be taught
Boys & Girls	25%	26%	53%	72%	17%
Girls	17%	50%	58%	92%	25%

Table 2: Influencing Factors as a percentage for boys and girls selecting the Engineering Diploma

There are significant differences in 2 areas – girls were twice as likely to be influenced by written literature and the visits to the university and CLC. It would suggest that this is because it raised the awareness of the different types of engineering and went someway to breaking down stereotypical perceptions. The girls were also more influenced by the visit to the CLC. This is a modern clean well-equipped centre with a mixture of office-like and workshop environments. Any perceptions of working in a dirty environment were dispelled.

In terms of the impact of studying the engineering diploma at 14-16 on future study and career choices, the survey indicated that it had a very positive influence on their choices showing a significant difference between this group and the wider survey by EngineeringUK.

Tables 3 provide the results to the question ‘Would you consider engineering as a career?’ and compares the data from the survey of the engineering diploma students with the national survey.

	Girls age 15-18	
Engineering Diploma students	46%	
EngineeringUK	28% (12-16)	14% (17-19)

Table 3: Percentage of girls who would consider engineering as a career.

Almost half the girls (46%) were very positive about a future career in engineering compared with 28% pre 16 and 14% post 16 results from the national survey.

The most striking output from this work is the outstanding impact that the engineering diploma has had on further study and career direction. 81% of first group has proceeded to study Engineering or STEM subjects representing 60% of the girls and 90% of boys in the cohort. From the second group 29% of girls have already selected STEM subjects and 48% of boys including 2 boys doing engineering Apprenticeships, 40% of this group have still to decide. The final group, who are currently in their final term of the Higher Diploma, all except one are intending to go into further education to study STEM subjects. Two have gained entry to the new Aston University Engineering Academy.

Focus group findings

The focus group session was with 7 girls from the current year 11 cohort and 2 from the year 13 cohort. The group's general comments about the engineering Diploma were positive.

When asked why they chose the course the main reasons were that it was worth 7 GSCEs, the emphasis on Personal, Learning and Thinking skills (PLTs) and the fact that it was taught in whole day sessions, in a new environment.

The response to 'their perceptions of engineering' prior to choosing the course was revealing in that they took the programme knowing very little about it. Apart from one student who had always wanted to be an architect or structural engineer the rest had little direct knowledge.

Feedback from students who had studied the course when asked to give a single word to describe engineering produced the following:

Creating, new inventions, advancement, necessary, design, development, manufacturing and industry, "put your goggles on"

When asked about what types of engineering there are they were able to come up with:

Civil, genetic , aeronautical, mechanical, chemical, marine, medical , electrical, structural, armed forces.

The focus group session was also used to explore the girls' experience of working in a male dominated environment.

When asked about any perceived difference in the way teachers treated girls and boys, (there was only one female teacher), the response was a resounding "No". However when they started discussing the issue there were a lot of "buts"!

Dynamics between the female teacher and her male team teaching partner were identified and interpreted by the girls. 'Mr Z and Mrs Y teach us together. Mr Z takes the main role. She's got more qualifications. Just because she's a woman she has to be the one who steps back. That's not kind of right.'

The importance of good female role models for girls is evident from the girls' comments on Mrs Y.

The results show that the effects of social stereotyping exist in the classroom. This is generally accepted as the norm by the girls but they do find some aspects of this frustrating. Needless to say there is an implication here for teachers and how they manage the learning experience.

Working with other adults was considered an important element of the delivery of the course by the teachers, and any concern about the male dominance of industrial input both in the learning environment, visits and work experience having a negative impact on girls pursuing a career in engineering was not apparent. The girls who selected the engineering diploma were mature and confident and had a positive experience in the workplace. They considered working with other adults rather than just teachers a very positive experience.

Although the ratio of girls to boys was much greater than the national average on the Diploma course girls were still in the minority and they were very astute in identifying differences in the way girls and boys learnt, group dynamics, effects of social stereotyping, the different skill bases of boys and girls and some elements of gender based curriculum projects.

Conclusions

This paper aimed to understand the reasons that so many girls had taken the Engineering Diploma and the reasons for the positive impact on girls' perception of engineering and their future education and career choices.

The insights provided show that the girls were attracted to a new and prestigious qualification that was to be delivered in a different way, different location and with input and visits from industry. The fact that it was an engineering course was almost a secondary influence! However, having opted for the course it proved to be a really positive experience. The application of the maths and science in a work setting and a clear view on exactly where their skills could be used at work has had a major impact in attracting girls into future study of science, technology , engineering and maths subjects and consideration of engineering as a possible career.

These findings show that if students are given the opportunity to study engineering from 14 at GSCE level and that the subject is delivered in an applied manner in partnership with industry they are much more likely to continue to study engineering or science and maths subjects and to consider engineering as a career option. This is the first time there has been evidence that enabling employers to input directly to the design and delivery of the taught curriculum has such a positive impact. The new University Technical Colleges for 14-19 year olds that are starting to open very much build on the learning and teaching approaches adopted for the Engineering Diploma but this employer enabled approach needs to be adopted more widely in the teaching of science, engineering and maths.

It is clear that the staff involved in the delivery of the programme were aware of the gender issue and created a positive experience for girls, but from the comments the learners made, there is scope for continuous improvement in this area. It provided further evidence of the importance of female role models. Further research is required in the areas of differentiation by gender. The Institution of Physics (Daly, Grant and Bultitude 2009) work on this has had a major effect on encouraging girls to continue studying physics in the participating schools. This type of project needs to be expanded into other science and engineering areas.

Information, advice and guidance (IAG) is essential in influencing perceptions of engineering. Careers services to schools are being cut and the main influence on student choice of study at 14 is teachers. More work needs to be done to ensure that teacher' have full knowledge of science and engineering career opportunities and strong links with employers for the benefit of the engineering education and their own professional development.

Lastly, an investigation into the Initial Teacher Training current opportunities, and whether these are adequate in providing the necessary number and quality of teachers who are able to create an employer enabled curriculum which has been shown to be highly successful in providing those insights to learners about work and further education options.

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