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ENGINEERING DESIGN, APPRENTICESHIPS & DIVERSITY

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ABSTRACT
This paper reports on a study that set out to understand the backgrounds of apprentices studying Engineering pathways at one Further Education (FE) College in the UK, where an integrated programme of qualifications from level 2 to level 7 exists. The research presented here follows on from a previous study that suggested diversity was very low across the programme. It also portrayed that progression opportunities to level 4 and above, that is, Higher Education, are not evenly distributed across the socio-economic groupings. The findings are representative in the light of relevant literature indicating concerns nationally and across sectors about Apprenticeship opportunities not being fairly distributed across socio-economic groupings.
The report concludes that there is a relationship between those from lower socio-economic groups being more likely to engage with craft type qualifications. These qualifications do not offer progression possibilities to Higher Education, unlike those from higher socio-economic groups. ; This is because higher socio-economic groups are more likely to engage with technical qualifications. The report offers suggestions for further investigation related to careers advice, and, as a result of these findings, recommends some interventions that might increase the diversity of the engineering Apprentice population.

Keywords: Apprenticeships, engineering, diversity, skills shortages, widening participation.

1 INTRODUCTION

This paper reports on an investigation into the backgrounds and progression opportunities of engineering design apprentices studying at a Further Education (FE) College on the South Coast of the UK. The FE College works in partnership with a local University; to provide an integrated programme. This programme includes completion of a level 3 apprenticeship through Higher National Certificate (HNC), Foundation Degree Engineering (FdEng), Batchelor of Engineering (BEng), to graduate with an Masters of Engineering (MEng) honours degree. All appropriate levels are accredited by the Institution of Engineering Designers.
Previous research indicated that progression opportunities were not evenly distributed across the socio-economic groupings; and that diversity is very low. Throughout this paper, the educational levels referred to, eg level 3, are those defined by the UK Government [1]. The FE College has approx. 300 level 2&3 apprentices, however, research already conducted into progression to level 4 study shows almost total domination by white middle class males, with white and male figures both being in excess of 90%. While progression by those from working class backgrounds, determined by postcode data, (less than 10%) or parental occupation, around 25%, is small.
This integrated programme was developed in collaboration with industry and all students studying at all levels of the programme are employed in the engineering design sector. Therefore, the paper fits with the theme of collaboration in industrial involvement in design education.
The research presents a quantitative data set on the backgrounds of HNC (level 4) and, more importantly, level 2 & 3 apprentices at one FE College. This report determines any relationships relating to the diversity of the apprentices' backgrounds and the type of qualification they are enrolled upon. The research also presents an understanding of the potential barriers to progression to level 4+ study and makes suggestions for interventions to improve the progression to level 4+ by apprentices with a more diverse range of backgrounds.

2 LITERATURE REVIEW

Report after report for many years has displayed the shortfall of engineers at all levels from technician to graduate professional engineer. The Engineering UK 2016 report [2] (p7) suggesting an annual shortfall "of 29,000 people with level 3 skills (Advanced Apprenticeship) and 40,000 with level 4+ skills (HND/C, foundation degree, undergraduate or postgraduate and equivalent)". This same report highlights the impact of disadvantaged backgrounds on young peoples' achievement at General Certificate of Secondary Education (GCSE) level. The most recent report 2016 IET Engineering and Technology Skills and Demand in Industry [3], suggests there are also issues related to the lack of gender and ethnic diversity among UK engineering employees.

Focus has been put on increasing the number of apprentices with the launching of the Institute of Apprenticeships in the Enterprise Bill of 2016 [4]. However, the Social Mobility & Child Poverty Commission, in their response to the Select Committee Enquiry into Apprenticeships [5] note "It also noted that, unlike academic courses, youth apprenticeships typically do not represent a step up: most A-level-age apprentices do GCSE-level apprenticeships and almost all (97%) university-age apprentices do apprenticeships at A-level equivalent or lower." and "The commission found some evidence that apprenticeships were not "open to all", with employers setting a minimum level of qualifications such as five good GCSEs in order to hire the best candidates."

In an article in The Independent newspaper Mr Milburn stated "Improving social mobility means tackling the stark inequity in who gets the best apprenticeship opportunities. More affluent children are twice as likely to start a Level 3 apprenticeship [equivalent to 2 A-levels] in some parts of the country than the less-off. The Government needs to step in to create a more level playing field to ensure that young people from all backgrounds are able to access high-quality apprenticeships." [6]

There is some evidence that this issue is being addressed by the Government in its funding for apprenticeships [7], whereby, additional funding will be available for those companies taking on apprentices from areas of multiple deprivation as determined by the Index of Multiple Deprivation (IMD).

The longitudinal studies of Smith, Joslin & Jameson [8] Joslin & Smith [10] and Joslin & Smith [9] tracked the progression of 6 cohorts of apprentices over a period of 6 years finding that around 19% progressed to higher education when tracked for a total of seven years. (Smith, Joslin & Jameson, [8] p8. However, it must be noted that this study tracked advanced level apprenticeships ie a level 3 qualification across all sectors. Thus this does not include all apprenticeships the majority, of which, are at level 2 (intermediate apprenticeship) with 58% being level 2 in Engineering & Manufacturing Technology (Higton, Emmett, & Halliday [11] p8). Joslin & Smith [9] p36 state that 37% of advanced engineering apprentices progressed to some form of HE in 2005/6, while the figure was 31% for 2009/10 (Smith, Joslin & Jameson [8] p36.

3 METHODOLOGY

This study sought to obtain data on the backgrounds of level 2 and level 3 Engineering apprentices, along with the Sept 2017 intake to the level 4, first year HNC Engineering (HNC1), all studying at the FE College. These apprentices are variously studying qualifications at level 2 City & Guilds (C&G) craft; level 2 C&G Technical Certificates (Tech); level 3 C&G; level 3 Business and Technology Education Council (BTEC) and level 3 subsidiary diploma (SD). It should be noted that the level 2 C&G Technical Certificate is a new qualification for this intake year and previously this route offered a level 2 BTEC certificate. The level of study (2, 3, 4 etc is set out Quantitative data was requested via questionnaire on: gender, ethnicity, age, Senior School attended, GCSEs obtained, occupation of parent/guardian, whether respondent had free school meals, post code of domicile while at school and whether their parent/guardian holds a degree. Qualitative data was also requested, on the same questionnaire, on their pathway through education post GCSE and the influences on their choice of careers.

The data was analysed using a combination of national widening participation (WP) metrics – free school meals; occupation of parent/guardian (based on coding from the Office for National Statistics (NS-SEC rebased on SOC2010)); whether parent or guardian has a degree and using POLAR3 quintile data to analyse postcode of domicile while at school (using the HEFCE Postcode Checker available at http://www.hefce.ac.uk/postcode/ . POLAR3 quintiles [12] indicate the likelihood of a young person from a specific postcode participating in higher education with quintile 5 being most likely and quintile 1 least likely. Actual percentages for each quintile vary considerably, however, the range for

areas significant for this study are quintile 1 – 10.4-19.1% and for quintile 5 – 47.5%-71.4% [13]. It should be noted that it is anticipated that IMD data, also based on postcode analysis, will be used by Institute of Apprenticeships to determine apprenticeship funding.
Ethical approval was sought prior to the commencement of the study and ensured all participation was voluntary with individuals being free to withdraw at any time. Anonymity has also been fully maintained throughout the research.

4 FINDINGS

Data on gender, ethnicity and postcode of domicile (expressed as POLAR3 quintile) was gathered from 406 respondents across the various qualifications and levels being studied by apprentices at the FE college for the academic year 16/17 as shown in Table 1. There are a total of 187 level 2, 155 level 3 and 64 level 4 respondents respectively and the population is overwhelmingly male and white. The anomaly in gender distribution at level 2 C&G Tech is the result of one company operating a positive discrimination policy for intake 16/17 in favour of females. It should also be noted that level 3 BTEC qualifications take two years so there are around 55-65 apprentices studying on each year of the level 3 BTEC qualifications.

Table 1. Respondents by qualification type & level studying for 16/17

	Quintile Description	Level 4 HNC1	Level 3 SD	Level 3 BTEC	Level 2 C&G Tech	Level 3 C&G Marine	Level 2 C&G Marine	Level 2 C&G EngMfg
Respondents		64	11	117	56	27	52	79
Male		60	11	112	43	26	49	74
Female		1		5	13	1	3	5
White		55	11	114	52	27	51	76
POLAR3 Q1		7(11%)	1(9%)	17(15%)	6 (11%)	6(22%)	24(46%)	17(22%)
POLAR3 Q2		2(3%)	1(9%)	13(11%)	12(21%)	4(15%)	12(23%)	14(18%)
POLAR3 Q3		23(36%)	5(45%)	49(42%)	11(20%)	9(33%)	11(21%)	25(32%)
POLAR3 Q4		15(23%)	4(36%)	26(22%)	13(23%)	6(22%)	2(4%)	12(15%)
POLAR3 Q5		13(20%)		9(8%)	13(23%)	2(7%)	3(6%)	10(13%)

In terms of their socio-economic status 11% entering the first level of Higher Education, that is, level 4 (HNC1) in Sept 2016 had postcodes of domicile while at school in POLAR3 quintile 1 ie those least likely to attend higher education, while 22% of these apprentices had parents/carers with class 4 or below occupations ie. Technical or craft occupations, semi-routine and routine occupations and unemployed. Similarly for Level 2&3 C&G Tech, SD & BTEC qualifications between 11-15% of apprentices are classed as being in POLAR3 quintile 1. This contrasts markedly with those entering level 2 C&G Marine Engineering, Marine Electrical and Composite (grouped as Marine in Table 1) qualifications where 46% of apprentices are classed as being in POLAR3 quintile 1and little less markedly at level 3 C&G of the same subjects, being 22%. However, only 22% of those apprentices on level 2 C&G Engineering Manufacture are classed as POLAR3 quintile 1, thus suggesting there is firstly, a difference in the backgrounds of those apprentices entering C&G, craft courses compared to C&G Tech and BTEC, that is, technical courses, and secondly, there is some difference in the backgrounds of apprentices entering C&G craft courses dependent upon the subject. It should be noted that the majority of apprentices on the Marine and Composites courses are employed by two organisations only.
For those commencing the first year of the HNC in September 2016 Table 2 shows their immediate progression route, ie what they studied in academic year 15/16:

Table 2. Immediate Progression Route to HNC

Total	SD – FE college	BTEC– FE college	BTEC – Other	A level	Level3 C&G + Maths	Mature	Overseas EU
66	18	24	10	6	3	4	1

For academic year 15/16 there were approximately 70 level 3 second year BTEC engineering apprentices at the partner FE College, of which, around 64% progressed to the HNC (level 4) with the majority of the remaining numbers entering directly from A levels and BTEC qualifications from other FE Colleges. This figure is much higher than that shown for engineering apprenticeships nationally, of just under 40%, by Smith, Joslin & Jameson [8]. Progression to the HNC (level 4) requires fours GCSEs A*- C including Maths and English and one A level or level 3 BTEC with Merit in Maths, equivalent to 32 UCAS points. It should be noted that level 3 C&G qualifications do not produce UCAS points and, therefore, do not allow access to the HNC programme or Higher Education in general.

Furthermore, Table 3 shows the educational pathway of 48 respondents, from the same cohort, to this point, post GCSE (level 2 if grades A*- C, level 1 if grade D or below) typically taken at age 16 years:

Table 3. Pathways to HNC enrolment

Pathway	No.
GCSE-Alevel3-HNC4	6
GCSE-Alevel3-BTEC2*-SD3-HNC4	2
GCSE-Alevel3-SD3-HNC4	1
GCSE-Alevel3-BTEC3-HNC4	11
GCSE-BTEC3-HNC4	15
GCSE-BTEC2-BTEC3-HNC4	9
GCSE-BTEC2-SD3-HNC4	3

*This qualification has now been replaced with level 2 C&G Technical Certificate

This would seem to confirm some of the findings of the select committee that apprenticeships do not represent a step up in qualification for many. Of 21 apprentices with A levels (level 3) only 6 (under one third) went directly onto the HNC (level 4) qualification and two even returned to a level 2 qualification, whereas, 11 spent another two years studying for a qualification of the same level they already possessed. For the 27 commencing an apprenticeship with GCSEs a better picture is apparent than reported by the select committee[5] with 15 going straight to BTEC level 3 qualification, representing just over half taking the step up.

Checking entry requirements on the FE College website indicates that the entry requirements for level 2 C&G (three GCSEs A*-C) or C&G Tech (four GCSEs A*-D) are very similar, and must include Maths, English and Science. Entry to level 3 BTEC requires five GCSEs A*-C including Maths, English and Science. Thus, it would appear that many apprentices are being recruited at qualification levels significantly above the minimum which, as the literature reports, are already a barrier to entry for many.

Apprentices on entering these courses come from a wide range of schools (around 30 different schools are identified in the data) over a geographical area with a radius of 50miles around the location of the FE College. There are only a small number of apprentices on each year of each qualification coming from each school ranging from 1 in many cases reaching as high as 7 in two instances. An analysis of the Senior schools apprentices attended does appear to reveal some interesting points. It would appear that apprentices that attended schools with catchment areas generally in POLAR3 quintiles 4 & 5are studying BTEC courses, many at level 3, whereas, apprentices that attended schools with catchment areas generally in POLAR3 quintiles 1 & 2 tend to study C&G and level 2 courses. A comparative example taking two schools is illustrated in Table 4.

Table 4. Apprentice school background related to qualification being studied 16/17

	Level 4 HNC1	Level 3 SD	Level 3 BTEC	Level 2 BTEC	Level 3 C&G Marine	Level 2 C&G Marine	Level 2 C&G EngMfg
POLAR3 4&5 school	8	0	10	3	1	0	5
POLAR 3 1&2 school	0	0	1	2		5	1

Given there is little difference in entry requirements for C&G and C&G Tech level 2 courses this raises a question about careers guidance.

5 CONCLUSIONS

The research set out to present a quantitative data set on the backgrounds of HNC (level 4) and level 2 & 3 apprentices at one FE College and to determine any relationships relating to the diversity of the apprentices' backgrounds and the type of qualification they are enrolled upon. It can be concluded that the overall cohort is not very diverse being almost entirely white and male and it can also be concluded that there is a distinct relationship between the apprentices' backgrounds and the type of qualification they are enrolled upon. Apprentices from lower socio-economic backgrounds are much less likely to be studying technical qualifications that can lead to progression to higher education than those apprentices from middle and upwards socio-economic backgrounds. There is also the suggestion that the school attended may be a contributory factor in this most probably in terms of careers advice rather than qualifications being the requirements for entry to level 2 craft (C&G) or technical (C&GTech) qualifications are almost identical. Also, this needs to be understood in the context of 58% of those progressing to level 4 HNC having parents/carers with class 1 or 2 occupations, who are most likely to also be providing careers advice.

For the particular FE College studied a greater numbers (64%) of Apprentices studying at level 3 make the transition to level 4 and thus higher education than the national average (<40%). It is likely that this is because there is a fully integrated suite of courses that make the transition between each level between 2 and 7 straightforward and because there has been significant employer engagement is setting up the provision. So as noted in a previous study this provision does provide the kind of alternative admission/progression routes … particularly when accompanied by pedagogical reforms and activities that build up socio-cultural capital and familiarity with HE. [14](p40) recommended by The National Strategy for Access and Student Success [14] and thus results in higher progression from level 3 to level 4. However, it has little impact on diversity when the decisions about who is given the opportunity to engage in the programme are outside the control of educational institutions.

The issue reported nationally of apprenticeships not providing the step up provided by academic study routes, can also be seen in this study. It is unclear whether this is related to funding issues or to recruitment of over-qualified apprentices for the level of apprenticeship required by the employer. Thus, a recommendation for further study is to investigate the recruitment processes and decision making of apprentice employer organisations.

The research also set out to consider the potential barriers to progression to level 4+ study and make suggestions for interventions to improve the progression to level 4+ by apprentices with a more diverse range of backgrounds. Clearly, one intervention, to overcome the gender barrier, made voluntarily by one employer was to have a positive discrimination policy in the recruitment of females, the effect is readily seen in the data, with 23% being female in that particular cohort, compared to the more typical <10%. As suggested above another barrier may be the careers advice that those from lower socio-economic groups currently receive. It is suggested that a further study investigates the careers advice provided to those from lower socio-economic groups. In particular, those in schools serving these groups; as the apprentices or their parents/carers may not have the understanding that students embarking upon a craft type qualification, even at level 3, does not provide the possibility of progression to level 4 and above and thus higher education.

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