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The impact of a year in industry on academic outcomes in higher education (engineering)

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ABSTRACT

Year-in-industry schemes provide new or enhanced skills beyond the academic environment, a context for consolidation for the academic skills and a maturity in the approach to subsequent studies. The present work aims to quantify the impact of the year in industry placement scheme on academic outcomes for engineering students according to whether or not they undertake a year in industry. The results show that the gain in grades is notable: +5.7% for students returning from placement to year 3 of a Bachelor. ANOVA tests show that the increase observed is not the result of expected variation. A detailed analysis reviews where in the curriculum, the benefits may be expressed. The analysis shows that the perception that students benefit from skills gained on the year in industry for their third-year project is mainly correct, but confounds causality and correlation. Finally, it is shown that students in lower grade categories prior to the placement benefit most from the year in industry. The year in industry in engineering is demonstrably beneficial to students. Some work remains to be done to define which competences are improved, or whether the gains are individual or quantifiable at the collective level with generalised trends.

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Year in industry; work placement; academic outcome; internship; work based learning

1. Introduction

Academic learning in higher education is undertaken by students in the expectation of a degree and ultimately a career. While higher education institutions strive to embed applications of learning and contextualisation within the curriculum, it cannot entirely reproduce the open-ended nature of professional engineering experience. Institutions that strive to embed the taught material in application are (rightly) held as exemplar but the case study from University College London (UCL) by Graham (2018) still shows that little time is dedicated to projects and professional skills compared to examinations. This highlights the importance of placement schemes embedded within the learning experience. For example, it is common in European engineering education cycles that a mandatory placement is included, such as the *stage de fin d'études* in the French engineer training cycle, or even a grounding placement before studies, *Grundpraktikum*, and a technical placement at the end of the German engineering training cycle, *F-Praktikum*. This study is set in the context of British institutions, following the European Credit Transfer and Accumulation System (ECTS) framework of studies, and the accreditation framework set by the Engineering Council (The Engineering Council 2014), neither of which mandates placements. As a consequence, the placements are optional and sanctioned by

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degrees *with a Year in Industry*, whereby the placement is undertaken as a sandwich scheme for the duration of whole academic year.

The most comprehensive recent review of the impact of placements on academic performance and students' qualities and skills was carried out by Inceoglu et al. (2019). Their review work included results quantified through scoring questionnaires about the participants self-perceptions of their competencies. This work focuses on quantifying the academic impact of year-long placements, specifically in engineering. Few prior works were found to address this directly. Table 1 summarises

Table 1. Selected prior works and their outcomes.

Author	Context information	Outcomes
Mandilaras (2004)	127 observations, UK, Economics, year-long elective placements.	A Probit model of degree outcomes for Economics graduates according to placement take-up showed that 'Opting to do the professional placement increases the likelihood of an upper-second-class degree by 30 percentage points'.
Blicblau, Nelson, and Dini (2016)	240 students, Australia, mechanical engineering undergraduates, mandatory placement undertaken either as long term (42%), short term (26%) or prior learning (32%).	Increase in grade after placement was noted: 'The increase of the mean was 4.12 with a 95% confidence interval of the difference ranging from 1.7 to 6.4. '
Gomez, Lush, and Clements (2004)	164 students, UK, biosciences, year-long elective placements.	Use of a multi-factor regression to predict grades shows a 3.82% average grade benefit is attributable to undertaking a placement.
CBI and Universities UK (2009)	Qualitative summary and recommendations to the higher education sector and industry; case studies.	Valuable data must have been generated to support the claims but cannot be traced quantifiably. 'The University of Surrey referred to analysis that suggested computer science students who had done a year's work placement got a better degree result, while The University of Hertfordshire's FIT programme suggests a similar effect'.
Tanaka and Carlson (2012)	Hong Kong (1,373 students, 8 faculties and schools including engineering, short mandatory placements) and Kyoto, Japan (7638 students, 7 faculties including engineering; 2-week elective placement).	Work-based learning has a definite positive impact on grade, can be used to build a grade prediction model after placement, but has a small impact compared to grades before the placement. The study highlighted the importance of placement structure.
Crawford and Wang (2015)	46 Chinese students in a UK HE Institution, Accounting and Finance, year-long elective placements.	The study showed positive outcomes balanced with a bias due to self-selection: 'Chinese students who undertake placements in the third year are seven times more likely to achieve good degrees (2.1 or 1st) [⋯] Chinese students who have a high prior academic achievement [⋯] from years 1 and 2 are likely to undertake placements.'
Crawford and Wang (2016)	268 students, UK, Accounting and Finance, year-long elective placements.	Highlighted differences in behaviour between UK and overseas students (placement scheme appears self-selective among UK students). Found a higher chance of 2:1 or greater after placement, but dampened by possible skew from self-selection.
Brooks and Youngson (2016)	777 placements students and 698 non-placement students, UK, arts, sciences and engineering disciplines.	40% of students improve grades, average grades improved across the placement students population.
Duignan (2002, 2003)	91 students, UK, business studies, year-long elective placements.	Study found that unstructured placements have no significant impact on academic performance. Universities must play a role in preparing the students and ensure that the architecture of placement promote learning transfer between the academic and industrial environments.
Reddy and Moores (2006, 2012)	2 studies consolidated: 424 and 6,586 psychology students in each study, UK, year-long elective placements.	Statistical analysis demonstrated improvement in final year after placement and further demonstrated that the placement benefits low achievers the most.

studies focusing on quantifying the academic impact of the year in industry and includes studies from other disciplines of higher education. It excludes the studies based on Likert questionnaires and perceived skill improvements, not to dismiss their value, but rather to establish a comparable basis for the present study. Two principal approaches are taken, whereby the studies focus on the probabilities of specific outcomes (typically increased grades), or on the statistics of grade evolution before and after a placement year. The latter approach is adopted in this study.

All studies point to an improvement of academic performance when students return to studies after a placement, however (Tanaka and Carlson 2012) highlighted the benefit of structuring the placement to ensure that it is a learning experience, and Duignan (2002, 2003) even states that it is a necessary requirement.

The studies show a variation in the sizes of the cohorts included, in the approach used to quantify the benefits. This study first aims to quantify the academic impact of the year in industry placement for engineering students, with statistically significant cohort sizes, and then provide an insight into how grades are affected according to other factors to better understand who benefits, and under what circumstances.

2. Context and analysis method

2.1. Integrated placement schemes

The study is set in the context of the placement schemes as structured in a typical degree scheme in the United Kingdom. The placement is not a mandatory requirement of the undergraduate training cycle for the accreditation of higher education degrees following AHEP by The Engineering Council (2014). It can be proposed to undergraduate students as an option to enhance skills and employability. This takes the form of a 'sandwich year', which is to say that the placement year is added between two academic years. The placement needs to be at least of equivalent duration to an academic year (40 weeks). Although it is not prescribed that the total duration of the placement is undertaken with a single host organisation, it is consistently the case in practice. It is academically recognised on the curriculum but it cannot be used in lieu of any taught component of the degree. The placements are not 'brokered' by the University, but they are secured by students competitively through a recruitment process led by the host organisations (largely private sector companies, also some charities, notably involved in conservation work). Other forms of placements can be undertaken by students such as part time work, or short term holiday placements. It is recognised that they enhance competencies and employability but are not registered nor sanctioned by the University. The year in industry placement is a non-scored component of the degree programme (only pass or fail) and therefore, students only receive a pass or fail grade, which is not used to calculate the final average grade upon graduation.

Following the recommendation of Tanaka and Carlson, and Duignan, the placement is structured in such a way that students build portfolio over the course of their placement. This portfolio includes four sections:

(1) The Health, Safety and environmental report: a brief assessment of the student's understanding of the rules in force in their workplace and their responsibilities.
(2) Three quarterly reports: In two sections, these reports are first an account of the students' activities, achievements and learning, then invites them to set their own development objectives and a plan to achieve them compatible with their work at the host organisations, and in agreement with their industrial supervisors.

The reports aim to provide evidence of the students' development against the UK-SPEC framework set by The Engineering Council (2013). They are complemented in appendices by a log of the training and courses attended by students and the industrial supervisor's feedback report.

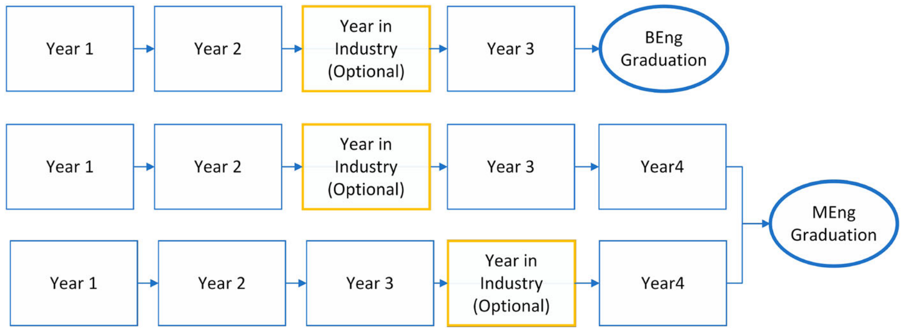

Figure 1. Degree pathways available for the undergraduate BEng and MEng schemes.

Figure 1 shows that there are three possible routes to undertake a placement. One on the bachelor scheme and two on the Master's scheme. While this can lead to difficulties in the analysis, the fact that students may undertake a placement at separate points of the curriculum may be used to identify whether the placement has an impact, or whether the students who were going to have better outcomes are simply the students who secure a placement. The present study offers a review of the impact of year-long placement based on a large data set collected from 1999 to 2021, where the differences in grades are analysed, as well as the probability of students' grade evolution according to whether a placement was undertaken.

2.2. Student groups

The data includes all students eligible for the year in industry programmes who have completed their studies. To be eligible, students must maintain an average grade of 55% or more at the end of their second year of study. The completion of studies may be a Diploma of Higher Education (successful completion of year 2), a Bachelor's degree (BEng, Honours or ordinary on completion of year 3), or an undergraduate Master's degree (MEng, Honours or ordinary on completion of year 4). The students are split in two main groups before being separated by degree scheme:

(1) non-year-in-industry students (non-YII): the students completed their studies without undertaking a year in industry.
(2) year in industry students (YII): students who completed their studies with a year in industry.

Note that the criteria applied means that to be included in the study, a student must have a known graduation outcome (therefore completed their studies) and a complete record from year 2 onward at least. This means that a significant proportion of earlier records were not used because incomplete, and among the later students, many were not included as they have not graduated yet.

These two groups are compared in their first three years of study in the first instance, then further study of the undergraduate Master's cohorts (MEng) is undertaken to provide a more detailed insight. The MEng cohort may undertake the placement before or after their third year; this is differentiated where relevant in this study. All disciplines of engineering are included: aerospace, chemical, civil, electrical and electronic, material, medical, and mechanical. All academic pathways other than year in industry are included, which includes the year abroad sandwich schemes. Only the year in industry scheme is separated from all others for analysis. Schemes with a year abroad are aggregated in the reference baseline data. This has the advantage of not excluding good students from the non-YII cohorts, which would artificially lower the baseline. It does have the disadvantage of confounding some factors such as the impact of added maturity in age and broadened experience.

A total of 21279 student-years is considered, representing 6124 distinct students. The continuity of yearly results to graduation outcomes is carried out at the query of the records and anonymised such that the student records and not traceable to individual students in the data extract held for the study.

Finding a placement for the year in industry is competitive with the recruiting companies running their selection process independently of the University. Not all students enrolled on a YII scheme attain a placement, thus not all students initially on a year in industry course do graduate to a degree with a year in industry, and conversely some students transfer to a year in industry course part-way through their studies.

The results are presented in three separate sections. The first explores the impact for students who undertook their placement between the years 2 and 3 of their studies. This is designated as the bachelor's group, but it also includes the master's students up to their third year. Master's students who undertook their placement between years 2 and 3 are naturally classed as YII students but those who completed the YII between years 3 and 4 are aggregated with non-YII students. This is because master's curricula cover the same syllabus as the bachelor's up to the completion of year three. The study in this section is designed based on the observation of grades evolution to identify trends and ANOVA tests to assert the statistical significance of any deviation.

The second section investigates the impact of the year in industry for those who graduated to an undergraduate master's degree, where the year in industry may place between years 2 and 3, or years 3 and 4 of studies. The two master's routes offer more nuanced insights into the impact of the year in industry. The approach of trend observation combined with a statistical test outlined above is also adopted.

The BEng and MEng analyses sections both include a first analysis using a one-tailed t-test to check whether grade distributions before and after placements are statistically similar or separate. The tests were conducted assuming unequal variance and using a significance level $\alpha = 0.001$. This is followed by an ANOVA test based on the change in grade between the years before and after placements using the same significance level $\alpha = 0.001$. The use of both tests enables to first confirm if student populations are similar, and then to determine whether the evolution of the grades of students who return from the year in industry are likely to be the result of random variations or not, thus answering

(1) Are the groups distinct?
(2) Could the grade evolution be within expected variation?

The following section delves further into the impact of the year in industry to gain insights into the nature of the benefits from the YII. In particular, it seeks whether there is a correlation between work-based learning experience and individual research project success in year 3. The numbers are further broken down to reveal who the students are that benefit most from the year in industry.

3. Bachelor's routes

3.1. Are BEng student populations distinct?

The students who attained a placement and eventually graduated to an engineering degree with year in industry are shown to outperform marginally their peers from the start of their study (0.5% in year 1, 1.2% in year 2, Figure 2). The gap in year 3 is much more significant: 5.7%. There is a flagrant change in the year 3 academic results based on whether students undertook a year in industry or not. The similarity in trends across groups until the placement occurs, and the divergence in grade evolution subsequently supports a correlation between the year in industry and the improvement of grades. The scenario of correlation rather than causality is retained at this stage, as skills tested in year 3 may align best with the skills required to attain be successful in the placement recruitment process. The first test applied to the BEng student population is the *t*-test described

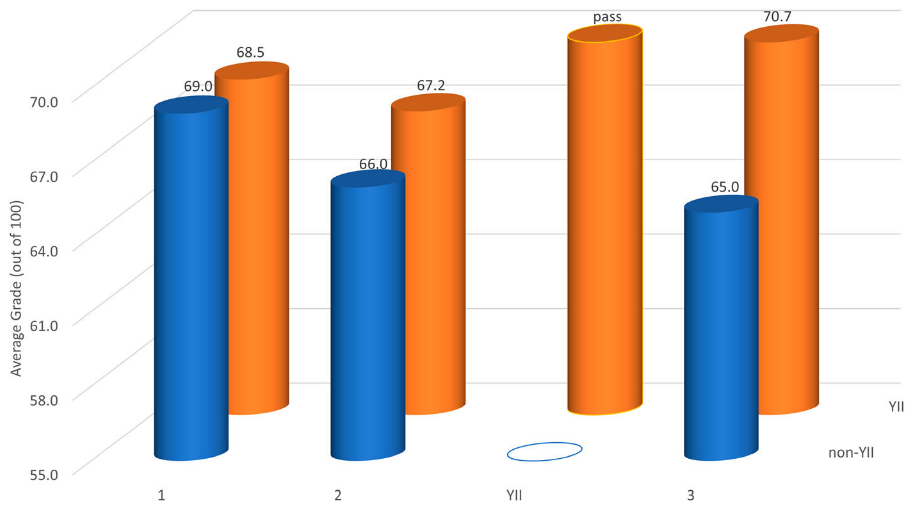

Figure 2. Average grade per year in considered degree scheme – all schemes are included up to year 3. The year in industry has a 100% pass rate so far and is therefore annotated 'pass' on the figure.

above. The results in Table 2 show that the *t*-value only exceeds the critical threshold for year 3, therefore excluding the possibility that the students returning from the year in industry are a subset of the general student population with a significance level of 0.001. The null hypothesis is therefore only retained for year 1 and year 2 (the two populations follow the same distribution) and rejected for year 3 upon return from placement.

3.2. Are grades evolutions significantly different?

The hypothesis for ANOVA test (single factor) is that the change in grade following the year in industry:

$$\left(\mathrm{GPA}_{\mathrm{year3}} - \mathrm{GPA}_{\mathrm{year2}}\right)$$

is greater for students who undertook a year in industry compared to non-YII students.

Null hypothesis: the year in industry student do not have significantly different grade evolution before and after their placement.

The statistical analysis first looks at the evolution of year average grade (GPA) then an ANOVA test is used to establish whether the deviation in outcomes is a significant departure from expected results when a year in industry is undertaken.

The statistical determination of significance by single-factor analysis of variance shows that the test value with a 0.001 significance level yields a *p*-value close to zero. The *F*-value computed for the student population analysed is 121.75, which exceeds the critical threshold, 10.54 (details in Table 3). It is therefore undeniable that the null hypothesis must be rejected, the groups are statistically distinct and therefore students who go on a year in industry achieve higher final-year grades than expected if they did not.

Table 2. Results of *t*-test analysis for the BEng students.

	Year 1		Year 2		Year 3	
	t-value	t_{crit}	*t*-value	t_{crit}	*t*-value	t_{crit}
non-YII against YII	1.29	3.11	2.17	3.11	**12.22**	3.11

Table 3. Single-factor ANOVA output on grade evolution for the BEng group.

Groups	Count	Sum	Average	Variance		
Y2-Y3	2902	−4540.81	−1.57	73.97		
Y2-YII-Y3	308	1114.04	3.62	46.32		
Source of Variation	*SS*	*df*	*MS*	*F*	*P*-value	F_{crit}
Between Groups	7476.42	1	7476.42	104.83	3.13×10^{-24}	10.85
Within Groups	228799.08	3208	71.32			

4. Undergraduate master's routes

The students who eventually graduate to an Engineering Master's degree (MEng) normally undertake their placement between the years 3 and 4. The Master's routes are subject to the same selective criteria and very little difference in performance is noted in the first three years of study. Studying the MEng cohorts separately is therefore of interest because it ensures a more homogenous level of academic achievement prior to the intervention, and because students can (and do) undertake their placement at two distinct points of the curriculum, it provides an insight into any effect is by causality or correlation.

4.1. Are MEng student populations distinct?

The study of the MEng cohort does not have the benefit of the BEng cohort in the weight of its statistical significance due to lower numbers, however it provides an insight into the real benefit of the year in industry scheme. The comparison of student performance on non-YII routes, YII with placement between years 2 and 3, and YII between years 3 and 4 shows that the uplift in academic performance is strongly linked to the return from placement against a homogeneous group of peers: an early placement yields a 4.1% uplift, while early and later placements deliver uplifts respectively of 2.6% and 2.7% in the final year of the MEng courses (Figure 3). The results of the *t*-test in Table 4 show that the students' grade distribution can be assumed similar until year 2 included, for those attending their placement between years 2 and 3, and until year 3 included for those attending their placement between years 3 and 4. The results demonstrate direct correlation between the return from year in industry and grade improvement by comparing the year in industry cohorts who undertook their placements at different times of the programme. The analysis of the years preceding the placement show that before placements, the students who will go on to undertake a placement are not statistically different from their peers will not (but are eligible to do so).

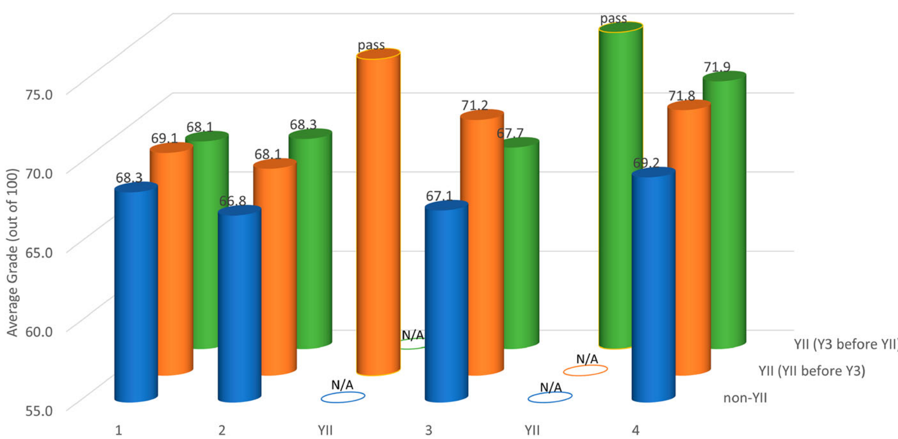

Figure 3. Average Grade per Year in Master's degree schemes. The year in industry has a 100% pass rate so far and is therefore annotated 'pass' on the figure.

Table 4. Results of *t*-test analysis for the MEng students.

	Year 1		Year 2		Year 3		Year 4	
	t-value	t_{crit}	*t*-value	t_{crit}	*t*-value	t_{crit}		
non-YII against YII between Y2 and Y3	0.738	3.142	1.879	3.140	**6.298**	3.142	**5.228**	3.140
non-YII against YII between Y3 and Y4	0.186	3.157	1.567	3.165	0.860	3.161	**5.233**	3.158

4.2. Are grade evolutions significantly different?

As with the BEng cohorts, the study uses a single factor ANOVA test as a second step to establish whether the change in grade between years preceding and following placement could be statistically expected. The hypothesis for ANOVA test (single factor) is that the change in grade following the year in industry:

$$\left(\mathrm{GPA}_{\mathrm{year3}} - \mathrm{GPA}_{\mathrm{year2}}\right)$$

is greater for students who undertook a year in industry between Years 2 and 3 OR

$$\left(\mathrm{GPA}_{\mathrm{year4}} - \mathrm{GPA}_{\mathrm{year2}}\right)$$

is greater for students who undertook a year in industry between Years 3 and 4.

The MEng route forces the consideration of two cases, but the null hypothesis remains the same as in the BEng case. The breakdown of 231 Master's students who completed the year in industry is:

(1) 99 MEng students completed their placement between year 3 and 4.
(2) 132 MEng students completed their placement between the year 2 and 3.

The analysis of variance shows that the difference between average grades is the result of a statistically significant intervention (Tables 5 and 6). The *P*-value indicates that there is a negligible probability that the observed year in industry grades may occur under the null hypothesis. It can therefore be excluded that the MEng YII results are simply a subset of the overall student population distribution and an intervention of significance has occurred. It may be worth noting that although the *P*-value in both study sequences are several order of magnitude below $\alpha = 0.001$, the difference in distributions is not as marked as observed in the Bachelor courses (3).

5. Who benefits (academically)?

5.1. Gender analysis

Analysis of the data by gender in Table 7 shows that the grade difference between male and female students is small on the Bachelor programme and female are proportionally in higher representation in the YII programmes compared to the non-YII programmes. They outperform their male counterparts by a small margin in the final year (around 1%) but fluctuations exist in the trends for years 1 and 2 of the year in industry programme. This may be due to the small population sample size.

Table 5. ANOVA output on grade evolution for the MEng group with YII following year 2.

Groups	Count	Sum	Average	Variance		
Y2-Y3-Y4	1276	402.57	0.32	48.73		
Y2-YII-Y3-Y4	132	407.54	3.09	35.11		
Source of Variation	*SS*	*df*	*MS*	*F*	*P*-value	F_{crit}
Between Groups	919.16	1	967.53	21.18	46.32×10^{-6}	10.87
Within Groups	62899.79	1406	44.74			

Table 6. ANOVA output on grade evolution for the MEng group with YII following year 3.

Groups	Count	Sum	Average	Variance		
Y2-Y3-Y4	1276	402.57	0.32	48.73		
Y2-Y3-YII-Y4	99	414.58	4.19	31.50		
Source of Variation	*SS*	*df*	*MS*	*F*	*P*-value	F_{crit}
Between Groups	903.72	1	403.72	12.20	4.94×10^{-4}	10.87
Within Groups	45442.32	1373	33.10			

On the Master's programme (Table 8), female representation is also higher on the YII programmes but they are outperformed consistently by their male counterparts (with the exception of the first year of non-YII schemes). Most notably, the female students on the year in industry scheme who choose to undertake their placement between years 3 and 4 are the only group of year in industry students that do not achieve a first class average grade in their final year (above 70%). At the group level, however, an average grade increase by 5.8% is observed between their performance before and after placement, this is the most significant increase.

5.2. Analysis of 'relative grade uplift'

Based on the evidence from ANOVA tests above, the uplift following the year in industry is a statistically verified outcome and it is credible that it may be acquired chiefly by experience, knowledge and skills rather than just time-acquired maturity based on the immediacy of the uplift upon return from year in industry shown between MEng cohorts. A relative uplift was formulated to compare the variation in grade of the year in industry cohorts to that of the overall student populations:

$$\left(\mathrm{GPA}_{Y3,YII} - \mathrm{GPA}_{Y2,YII}\right) - \left(\mathrm{GPA}_{Y3,non-YII} - \mathrm{GPA}_{Y2,non-YII}\right)$$

The results are presented in Figure 4. The series are based on year in industry attendance and the data is broken down in grade bands from the students' year 2. The data plotted shows the change in grade between year 2 and year 3 (the uplift) and the labels show the number of students in each set as well as the *relative* uplift gained by attending the year in industry. Note that the marks used in the study are exact, whereas the marks used for the programme selection threshold are rounded up as retained on transcript. Consequently 25 students on the year in industry and 97 students in the baseline group are in the 45% –55% band, whose calculated average grade would have been between 54% and 55%. The candid observation of results is not entirely as expected. As a general baseline the third year appears as a leveller rather than a discriminator. Students with grades previously in upper-second-class categories or below achieve higher grades, and the grades of students in first-class category decrease. The year in industry students do see a relative uplift compared to their peers regardless of the grade group in which they sit in year 2, with the most notable impact on those with year 2 average grades in the lower three bands. The uplift in grades for students who only marginally qualified for the scheme is of very high individual impact (over 12% grade improvement and 5.2% relative uplift), although due to low numbers, it has little collective impact. The figures

Table 7. Yearly average grades by gender (BEng programmes; M: male students, F: female students).

	Non-YII M	Non-YII F	Non-YII (all)	YII M	YII F	YII (all)
	84.3%	15.7%	4183	70.9%	20.7%	440
Year 1	68.9	69.2	69.0	67.9	70.9	68.5
Year 2	65.9	66.4	66.0	67.3	67.0	67.2
YII (opt.)	/	/	/	Pass	Pass	Pass
Year 3	64.8	65.9	65.0	70.5	71.4	70.7

Table 8. Yearly average grades by gender (MEng programmes; M: male students, F: female students).

	Non YII			YII: placement before Y3			YII: Y3 before placement		
	M 86.5 %	F 13.5 %	All 1276	M 82.6 %	F 17.4 %	All 132	M 82.8 %	F 17.2 %	All 99
Year 1	68.3	68.5	68.3	69.3	68.3	69.1	69.1	63.1	68.1
Year 2	66.9	66.1	66.8	68.1	68.1	68.1	69	64.8	68.3
YII (opt.)	/	/	/	Pass	Pass	Pass	/	/	/
Year 3	67.2	66.9	67.1	71.3	70.7	71.2	68.7	62.9	67.7
YII (opt.)	/	/	/	/	/	/	Pass	Pass	Pass
Year 4	69.2	69.2	69.2	72	70.5	71.8	72.6	68.7	71.9

from the placement scheme show similar trends but their significance is doubtful due to relatively low numbers. The detail of uplift on return from the year in industry is given in the labels of Figure 4 for each category considered.

5.3. Impact on final degree classification

Ultimately, the year in industry is a significant contributor in the achievement of good degrees. This is demonstrated by the very significantly altered distribution of degree classification between students who graduated to a year in industry degree and those who were eligible, yet did not go on the year in industry (Figure 5). The degree outcomes shown are based on the following degree classification bands:

First Class Honours:	70% and above
Second Class Honours, Division I (upper):	60% to 69.99%
Second Class Honours, Division II (lower):	50% to 59.99%
Third Class Honours:	40% 49.99%

The degree average grade is calculated as a weighted average of the yearly average grades from year 2 (weight 1), year 3 (weight 2), and year 4 (if applicable, weight 2).

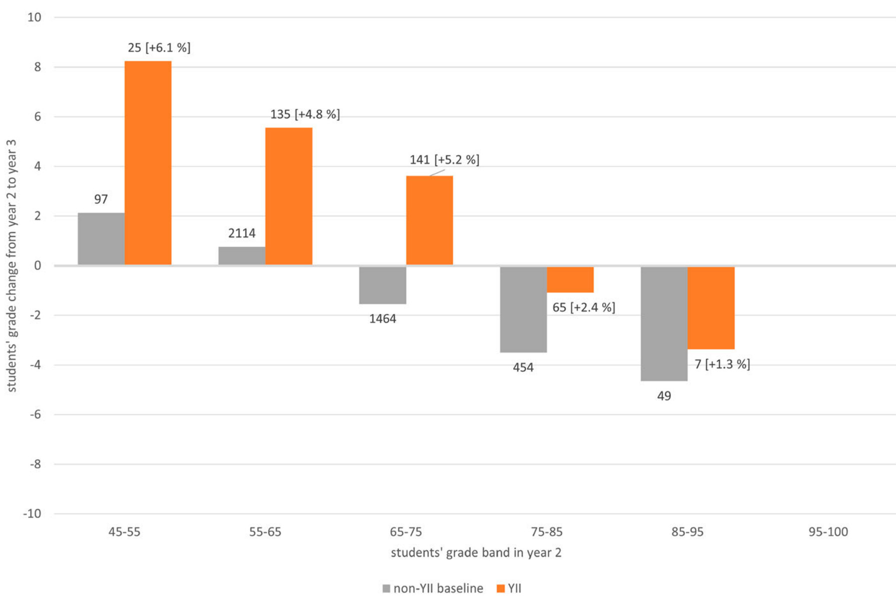

Figure 4. Change in students' yearly average grade from year 2 to year 3, labelled with group size.

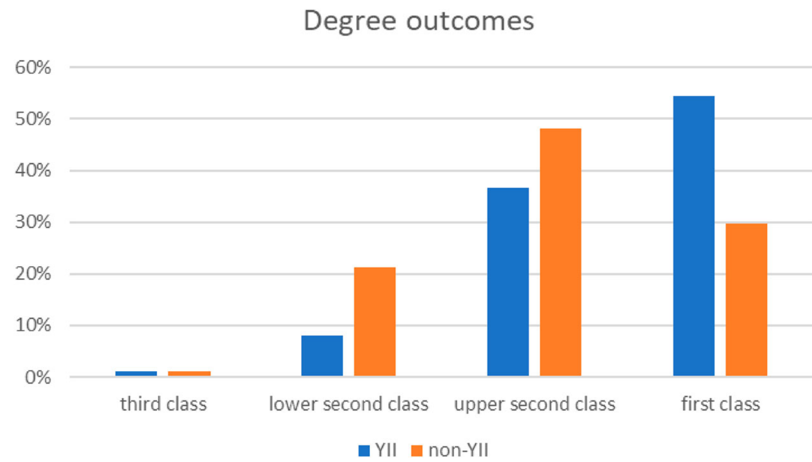

Figure 5. Distribution of degree classification outcomes depending on the completion (or not) of the year in industry – graduands only shown.

6. Is the impact as could be expected?

In their third year of study, all engineering students except chemical engineers undertake their individual research project. It is the only module common to a high proportion of the cohort considered (83%) It has been anecdotally reported within the institution that students benefit most from skills acquired on placement during their year 3 individual research project. This may because it depends on personal skills as much as, if not more than, technical skills, such as independent learning, organisation and planning, self-determination, resilience and motivation. These skills are often developed on placement. Overall, the research project average mark is 69.4% across the student population who have completed their degree and were eligible for the year in industry scheme. There is correlation between participation in year in industry and higher grade in the personal research project, with 6% higher average across the BEng cohorts and 3% across the MEng cohorts (Figure 6). The average grade for the third-year individual project is 74% for MEng students regardless of whether they undertake their placement before or after their third year (119 before and 55 after). While the uplift effect on overall grade is clear from Figure 3, it would be wrong to attribute causality of uplift for this particular module to the year in industry without further examination. Instead, the correlation is likely based on character in the students who show key skills required to complete the projects to a high standard and obtain a placement too (self-determination). The common denominator in all uplift effect appears linked to the students' determination to go and learn beyond the baseline of getting a university degree.

7. Discussion

The results from the study highlight several trends:

(1) BEng students have significantly higher grades than their peers upon return from placement.
(2) MEng students have a higher grades than their peers upon return from placement.
(3) All students' uplifts in grades upon return from placement was shown to be outside the expected grade evolution based on the non-YII control group.
(4) Although gender based differences exist, the female representation in engineering is low, which makes it difficult to identify trends, but it is clear that female students are more highly represented in the YII than in the non-YII cohort.

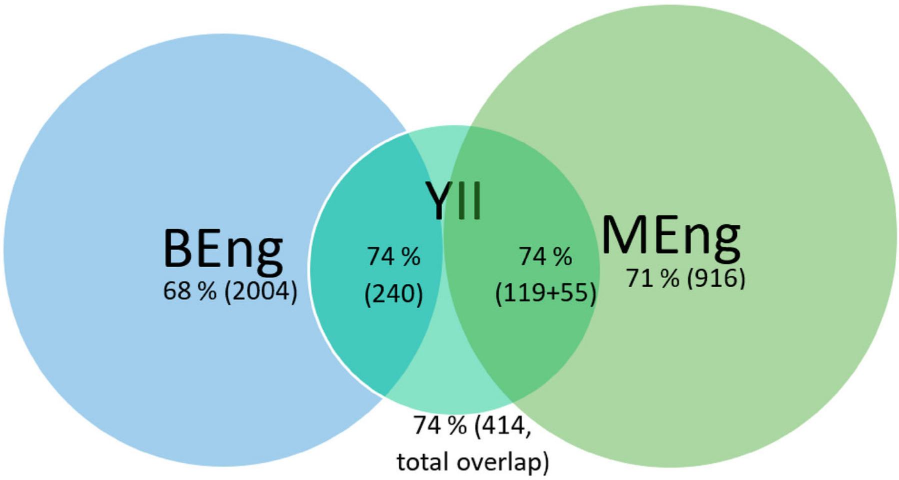

Figure 6. Research project grades per student category. Project marks achieved are indicated with the number of students in brackets.

(5) Students in the lower eligible grade categories prior to placement have the greater benefit from their placement.
(6) Although there is correlation between high achievement in the research project and YII attendance, the order of attendance in the MEng groups indicate that it is correlation, not causation. This is in opposition with the overall grade uplift, which shows a more direct, immediate correlation with return from placement.

The outcomes are in confirm those of Blicblau, Nelson, and Dini (2016), Brooks and Youngson (2016), and in a different field, those from Gomez, Lush, and Clements (2004) regarding an increase in grade of the order of 4%. The present study highlights differences in gains between students on a BEng or MEng programme. All students included for the study were subject to the same eligibility threshold of 55% average grade at the end of their second year. The same criterion is applied for students to enter the MEng programme. It is therefore possible that students aiming to complete a Master's programme already have a motivation to do better than *just pass*, which explains why the gains are less significant in their case. While this is a proposed explanation, it is an admittedly speculative hypothesis to open work with qualitative data complementary to this study. The degree outcomes are also in line with cited prior work from the fields of economics, business, accounting and finance (Mandilaras 2004, Crawford and Wang 2015, 2016). Unlike the works of Mandilaras (2004), the present study finds that the degree outcomes favour first class degrees (with 55% of YII graduation outcomes), 20% above the non-YII expected outcome. This uplift might be due, in part, to the institution's own grade distribution, and maybe to some extent due to the field, but what remains is a notably different degree outcome distribution.

The trends regarding students who benefit most are also supported by prior work in the field of psychology by Reddy and Moores (2006, 2012) who found that lower achievers prior to placement gained the greater uplift in grades.

The placement scheme considered is structured with academic support, regular reports and reflective aspects for the students to consider their own professional and personal development. This is an indicator that the placements undertaken by the students are indeed set up to maximise their benefit according to Tanaka and Carlson (2012) and Duignan (2003), but it does not test the benefit of the intervention proposed by Duignan (2002), as the placement structure has been in place for longer than the records used in this study.

Unlike the works of Duignan (2003), Crawford and Wang (2015), this work does not find indicators of self-selection *on academic criteria*, as evidence by the results of t-test prior to the placement year when all students compared (YII and non-YII) are subject to the eligibility threshold. Moreover, observation of the variance in the uplift between year 2 and year 3 shows a significantly more consistent progression for BEng and MEng students (Tables 3, 5 and 6). This indicates a more consistent and conclusive trend than observed by Mansfield (2011), who described high variability in the placement students' outcomes.

Although the present study endeavours to present datasets in the context of grade evolution, with the perspective of the pre-placement years, it is acknowledged that other factors could influence the outcomes, some of which may be protected characteristics (Equality Act 2010), socio-economic background, or prior extra-curricular attainments.

8. Conclusion

This work laid out a comparison of achievement between engineering students undertaking a year in industry placement and those who do not, in absolute form and compensated for prior achievement. Subgroups were then extracted based on gender and prior achievement, to identify trends. Finally the impact was traced to graduation outcomes and studied for potential impact in year 3 research projects.

The study demonstrated the benefit of the year in industry in its impact on academic performance upon return from the placement year. An uplift of 5.7% was noted on average for BEng year in industry students against their peers who did not undertake a placement.

Further analysis showed that those who benefit the most are the students with lower grades, limited to the extent whereby they qualify for the year in industry scheme. Although students with grades below 70% are the only ones who appear to benefit in the evolution of absolute grades, comparison with non-YII peers show that high achievers also outperform their peers in relative terms.

A perceived benefit of the year in industry was a student's ability to better manage a year-long project and independent learning, which would be expected to result in higher grades in the individual research project. While the data confirms that the year in industry cohort have higher scores, the link to third year research project is shown to be correlation rather than causality. The study focuses on the effects of the year in industry specifically against other cohorts. Further work is ongoing to assess the impact of the year in industry against the year abroad. This will help to establish whether the main driver of the uplift is the work-based learning experience, or the maturity acquired from spending a year in a new and broadening context. An extension of the study could systematically review students' performance in each subject, linked to learning outcomes.

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