
Work Placements Enhance the Academic Performance of Bioscience Undergraduates

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ABSTRACT The UK Government's recent emphasis on the graduate workforce raises the profile of work placements within higher education. Anecdotally, the authors find that students on their optional bioscience sandwich degrees benefit academically from placement experience but there is little supportive evidence of this in the literature. To investigate rigorously the link between sandwich placement and academic performance, two cohorts of bioscience students ($n = 164$) were described in terms of gender (male = 0, female = 1), pre-university qualifications (HESA score), academic performance (%) for each year of degree study (first, second, and final), and mode of study (non-placement = 0, placement = 1). Multiple regression analysis yielded the following predictive equation where all terms were significant: Final % = $28.80 + 2.97$ (gender) + 0.14 (HESA score) + 0.44 (Second%) + 3.82 (mode). On average, placement students gain an advantage of nearly 4% in their final year performance. Given that the final year contributes 75% towards degree classification, over a quarter of placement students may benefit from the independent effect of mode of study by crossing a threshold into a higher degree class.

Introduction

Two highly influential policy reviews of the provision of higher education in the United Kingdom – the Dearing review of Higher Education (1997) and the United Kingdom Government's Department for Education and Skills' White Paper on Higher Education (2003) – both stress the involvement of industry in the education of undergraduates. Dearing (1997) advocated that universities provide students with the opportunity to undertake work-based learning, whilst the White Paper stressed the contribution higher education (HE) can make to the economic and social well-being of the nation both by working with business and by powering the economy through producing a future graduate workforce with

appropriate and relevant skills. Although purists within HE may question the role that university education is expected to play in producing a workforce, graduate employability is high on the Government's agenda and may well become an increasingly important factor for undergraduates required to repay loans taken out to finance their studies.

Universities that address work-based learning and employability issues use a variety of approaches. Perhaps one of the oldest and most effective ways to prepare graduates for the workplace is through industrial placements. Many United Kingdom universities offer four-year sandwich degrees in which one of the years, most often the third, is spent gaining work experience related to their degree subject. Students opting for sandwich degrees are better placed for employment when they graduate compared with students who lack this experience (Bowes & Harvey, 2000), reflecting the conclusion that 'placements are seen by employers and graduate employees as the single most significant missing element of the majority of degree programmes' (Harvey et al, 1997).

In addition to students gaining valuable employability skills, academics involved with sandwich degrees have anecdotal evidence that students returning from a 1-year placement perform better in their final-year studies compared with students who did not go on work experience. Although improvement in academic performance is not one of the intended outcomes of going on placement (Duignan, 2003), such an effect would certainly be welcomed. Daniel & Pugh (1975) suggested that the academic benefits of the placement experience were largely unrealised, while Ryan et al (1996) commented on the lack of studies to quantify the academic impact of placement. Indeed, the paucity of literature in this area supports these comments. If work experience is able to enhance academic performance, it is worth exploring how this occurs and how it can be optimised. First, however, it is important to establish empirically if placement experience enhances academic performance and this is the principal aim of the present study.

Within our own institution, we have been offering BSc (Hons) full-time/sandwich degrees in the biosciences for over 30 years. The introduction of a modular degree scheme within the institution has allowed flexibility of choice of modules so students can follow a variety of routes to achieve specific degrees in a number of bioscience subject areas, such as genetics, microbiology, or human physiology and pharmacology.

Our four-year sandwich degrees are organised so that the first year is accredited with 120 Level 1 (L1) credits, but the marks achieved do not contribute to degree classification. The second year attracts 120 Level 2 (L2) credits and the marks for the best 100 credits contribute 25% to the overall degree classification. The sandwich year occurs in the third year (Level 2p) and is valued at 120 'p' credits; these are notional credits that

do not contribute to credit accumulation for the degree, but do confer the title 'sandwich' to the degree. The fourth and final year attracts 120 Level 3 (L3) credits, of which marks for the best 100 credits contribute 75% of the overall degree classification. A compulsory research project, conducted in the final year, contributes 40 of the 120 L3 credits.

Recognising the diversity of work experience offered by different placements, the assessment of the sandwich year is necessarily basic. Four elements need to be passed satisfactorily:

- a 40-week placement period;
- a visiting tutor's report based on an on-site visit;
- an employer's report;
- a 5000-word report submitted by the student at the end of the placement.

Each element is assessed as a simple pass or fail.

Although advertised as sandwich degrees and although students enrol for the sandwich route, the bioscience degrees are non-professional programmes and, therefore, the placement year is ultimately optional. In recent years there has been a significant reduction in the number of students opting to go on placement. This trend has coincided with a greater number of referrals in the final year, mainly involving non-placement students. The importance of a successful sandwich year in terms of employability and this crude indicator of academic performance are stressed to all students in the first and second years. In an attempt to investigate more rigorously the effect of the placement experience on academic performance in the final year, we conducted a study in which academic performance, as judged by aggregate mark for each year of study, was compared between students who opted for the placement year and those who did not.

Methods

Population Sample

The population sample comprised students who enrolled between 1996 and 1998, and who graduated in 2001 or 2002; this provided a large enough sample to conduct the analysis ($n = 164$). The sample was described in terms of gender, Higher Education Statistics Agency (HESA) score (a measure of student attainment in pre-university qualifications), L1, L2 and L3 aggregate marks (as percentages), mode of study (either the four-year route, including the placement year [SW], or the three-year route without the placement year [FT]), year enrolled and year graduated.

Analysis

The data were summarised and *t*-tests carried out to compare mean marks at each level by gender and mode. Multiple regressions were carried out by coding mode and gender as dummy variables (full-time = 0/sandwich = 1, male = 0/female = 1) with L1, L2 and HESA scores as other dependent variables (an approach effectively equivalent to an analysis of covariance with mode as a factor, and L1 mark, L2 mark, HESA score and gender as covariates). The residuals were checked for normality and any evidence of multicollinearity.

The students were considered as a single set and then as two sets – those for whom we had HESA scores and those for whom HESA scores were not available (a small minority, predominantly those joining the degrees via a Foundation year or with an HND).

Results

Gender and Mode of Study

In the two graduation years under study, female students made up the majority of the sample population (115 females versus 49 males). Overall, about 75% of the sample population followed the sandwich route and 25% followed the full-time route (Table I).

Mode	Male	Female	Total
SW	33 (67%)	89 (77%)	122 (74%)
FT	16 (33%)	26 (23%)	42 (26%)
Total	49	115	164

Table I. The sample population by mode of study and gender. SW, sandwich route with placement year; FT, full-time without placement.

Comparison between Year of Graduation

In a comparison between the two years in which students in the sample population graduated, there were no differences across the two years ($p > 0.9$) in terms of HESA scores and level aggregate marks (Table II). This indicates that the year of graduation did not affect achievement and supports further analysis of the data as a single population.

Comparison between Gender and Academic Performance by Level

A comparison between male and female students at the start of the degree, as based on their HESA scores, and at each subsequent level during the degree showed no significant difference except at Level 3,

where female students performed significantly better than their male counterparts (Table III).

Year of graduation	HESA score	Level 1 aggregate score (%)	Level 2 aggregate score (%)	Level 3 aggregate score (%)
<i>2001</i>				
Mean	12.7	52.4	60.0	60.0
<i>n</i>	57	79	78	79
SD	7.2	16.9	8.9	7.5
<i>2002</i>				
Mean	14.0	57.7	59.4	61.6
<i>n</i>	63	85	85	85
SD	8.8	13.9	10.2	7.3
<i>Total</i>				
Mean	13.4	55.1	58.2	60.9
<i>n</i>	120	164	163	164
SD	8.1	15.6	9.6	7.5

Table II. The HESA and Level aggregate scores for the two graduation years.

Assessment	<i>n</i>	Mean (% except HESA)	SD	<i>p</i> (two-tailed)
<i>HESA</i>				
Male	40	14	7.0	NS
female	80	13	9.0	
<i>Level 1 (L1)</i>				
Male	49	54.7	13.5	NS
Female	115	55.3	16.5	
<i>Level 2 (L2)</i>				
Male	49	56.6	9.4	NS
Female	114	59.0	9.7	
<i>Level 3 (L3)</i>				
Male	49	58.1	7.5	<i>p</i> < 0.01
Female	115	62.0	7.2	

Table III. Unpaired *t*-test analysis between male and female student performance on entry to the degree and at each level of study demonstrates a significant difference in the final year (Level 3).

Predictors of Level 3 Performance

A multiple linear regression analysis was performed on Level 3 aggregate percentage as a function of gender, mode of study, Level 1 aggregate,

Level 2 aggregate and HESA score. In running this model, the influence of Level 1 aggregate mark was found to be non-significant in the presence of the other independent variables so the analysis was repeated excluding this variable. The results (Table IV) clearly illustrate that each remaining independent variable has a significant predictive effect on final-year academic performance. Although the magnitude of the effects varied, mode of study was the non-academic variable with the greatest influence. As an equation, Table IV can be expressed as follows:

$$L3\% = 28.80 + 2.97 (\text{gender}) + 0.14 (\text{HESA score}) + 0.44 (L2\%) + 3.82 (\text{mode})$$

	Coefficient	p value
Constant	28.80	<0.001
Gender	2.97	<0.01
HESA	0.14	<0.02
Level 2	0.44	<0.001
Mode	3.82	<0.001

Table IV. Factors contributing to final-year performance.

Multiple linear regression analysis of Level 3 aggregate percentage as a function of the other recorded variables initially indicated that the effect of Level 1 aggregate was non-significant. The repeat analysis ($r^2 = 0.579$, $n = 115$) excluding this factor reveals that gender, mode of study, Level 2 percentage and HESA score all have a significant predictive influence on the overall final year mark.

Discussion

The study clearly demonstrates that students taking a sandwich placement exhibit improved academic performance in their final year – on average, placement students will gain an advantage of nearly 4%. Given that the final year contributes three-quarters of the marks used for determining the degree classification, this suggests that more than a quarter of the bioscience placement students may benefit from this independent effect of mode of study by crossing a threshold into a higher degree class.

Combining Data from Two Years

The decision to combine the data for students over two consecutive graduation years was made for several reasons:

- to increase the sample population size;
- to reduce the risk of picking an atypical year;

- to avoid introducing complicating factors, such as changes in the nature and content of modules, and the composition of the lecturing staff that might occur over a longer time period.

The analysis (Table II) suggests that the two years under study were similar enough to pool the data to form one population.

Effects of HESA and L2 Scores

The relative effect of the placement can be appreciated by comparing its contribution with the other independent variables studied. It might be expected that students with higher A-level (HESA) scores would perform better in their studies. Our analysis shows that HESA contributes less, on average, to the final-year (Level 3) mark than placement; for example, the predicted effect on final-year aggregate of an average HESA score of 13.4 would be 1.88% compared with 3.82% for placement. The relatively small effect of the HESA score on final-year aggregate may well reflect the fact that HESA is an 'out of date' measure of achievement by the time the students reach the final year, and also that it reflects achievement in a radically different teaching and learning environment, i.e. pre-university.

Conversely, the teaching and learning environment of the second year bears a greater similarity to that of the final year, so the magnitude of the Level 2 coefficient (0.44, Table IV) and its larger predictive contribution to Level 3 performance is not surprising.

Gender

Although some studies have shown a lack of effect, female students are often credited with better academic performance than their male counterparts (Pargetter et al, 1998). The data in the present study indicate that male and female academic performance was similar across the early years, and only showed a difference in the final year (Table III), for which the regression analysis indicates an independent effect of female gender of 2.97% (Table IV). As the effect of gender appeared towards the end of the students' stay at university, given the improved performance of both male and female students taking third year placements, it was interesting to see if female placement students benefit more than their male equivalents. This putative interaction between gender and mode on final-year performance was investigated through a univariate analysis of variance. No demonstrable effect was found ($p > 0.1$), indicating that placements are similarly beneficial to males and females alike.

Mandilaras (2004) also studied the enhancement of academic performance by placements and found that female students outperform

male counterparts in achieving a 'good' (first or upper second class) degree.

*Do Better Students Go on Placement and Do Better Students
Gain More from a Placement than Less Able Students?*

With the relative paucity of studies providing evidence for the academic benefits of placement and the consequent reliance on anecdotal observation, it has been difficult to determine the validity of the following suppositions:

- that it is the more academically-gifted students that go on placement;
- that the better students gain more from a placement than less able students.

Interestingly, with respect to the first proposition, a *t*-test comparing the HESA scores of sandwich and full-time students suggests that students who would later go on placement had significantly higher HESA scores (mean 14.4 ± 8.3 SD, $n = 87$ versus 10.6 ± 6.7 , $n = 33$, $p = 0.02$). At Level 1, no significant difference was seen between sandwich and full-time students' percentage aggregate (mean 57.5 ± 14.3 SD, $n = 122$ versus 48.2 ± 17.4 , $n = 42$, $p = 0.36$), whereas the gap in performance reappeared at Level 2 (mean 60.1 ± 9.6 SD, $n = 122$ versus 52.7 ± 7.3 , $n = 41$, $p = 0.025$). Although this observed pattern in behaviour cannot be explained with the available data, it is possible that differences may be linked to student aspirations, confidence, motivation, and academic record or performance at placement interview. For Level 1, it should be noted that the marks do not count towards degree classification.

With regard to the second suggestion, the inclusion in the multiple regression analysis of an interactive term between mode (SW/FT) and Level 2 performance failed to demonstrate significant interaction ($p > 0.7$); this indicates that however well or badly a student performed at Level 2, going on placement has a statistically similar beneficial effect on their final-year marks.

Different Findings of the Effect of Work Placement

There are a limited number of quantitative studies looking at the effect of work-placements on academic performance. In one of these, Duignan (2002) compared the academic performance of business undergraduates who undertook a placement with those who did not. He found no significant difference in academic performance between both groups and concluded that the results undermined the argument that placement will enhance student performance on return to studies. Duignan suggested that the lack of evidence of beneficial effect did not necessarily mean that

the placement students failed to learn from their experience; rather there was a failure fully to exploit the learning potential of the placement with respect to those attributes commonly valued and evaluated by academics in HE. Reasons for this included issues of motivation, the nature of the processes of learning transfer, and the structure and management of the placement (Duignan, 2002). He considered that the placement student is a 'transient' in the workplace, 'suspended' between two different worlds with distinctively different value and reward systems, which is perhaps manifested as demotivation on return to studies and a loss of learning transfer. In our experience with bioscience placement students, the work-experience is tied closely to their academic studies. Students work in the laboratories of hospitals, research departments and commercial companies. Furthermore, work-supervisors often stress that the students are treated as normal employees such as research assistants, rather than as students. They are often given responsibilities equivalent to those of full-time staff and up to a quarter expect to graduate with co-authorship of a scientific publication as a result of their placement work. In inhabiting a transient position in the workplace is a factor leading to the demotivation of the business students in Duignan's study, we can speculate that this occurs, to a lesser extent, in the present study and might partly account for the different results obtained. Furthermore, there may be a difference in the perceived and actual relevance of placements to the academic environment, similar to that found for some engineering students (Au Yeung et al, 1993). More in line with the present findings, however, an investigation of 120 economics students by Mandilaras (2004) found that those who participated in the placement scheme significantly increased their chances of obtaining an upper-second or first class degree.

In all studies, however, a certain degree of caution must be exercised in concluding a straightforward causal effect of placement on academic performance, since that demonstration would require arranging for students who deliberately chose the full-time route to go out on placement, and vice versa, for it is possible that those factors that predispose a student to take a placement might be linked to those that determine academic performance. Indeed, as mentioned earlier, analysis indicates that differences in academic performance existed between sandwich and full-time students prior to the placement year. These cannot fully account for the difference, however, since the multiple regression analysis reported in Table IV demonstrates an effect of the sandwich year independent of these other factors.

Benefits Prompt More Challenges

The apparent beneficial effect of placement on academic performance prompts a number of questions, including which particular aspects of the

placement experience might be responsible for enhancing academic performance. As Duignan (2002) puts it, 'it is not self-evident that work experience translates into enhanced academic performance, so what is the transmission mechanism?' The National Council for Work Experience (undated), however, propose that 'work experience greatly enhances teaching as students return with improved subject knowledge, understanding and skills'.

Mandilaras (2004) suggests some explanations for the improvement:

- The placement students mature more rapidly working in an often competitive and professional environment; their ambition is stimulated, and they return to university more focused and determined to do well.
- Workplace responsibilities may enhance their reliability, so they may take coursework and exams more seriously, and work more effectively to deadlines; as a result of this, academic studies would become more relevant and time management more appreciated.

One simple factor that may be important is that students returning from placement are tackling the rigours of the Level 3 study 1 year older than they would otherwise be.

Benchwork and Project

The majority of the bioscience placements involve benchwork in a laboratory where specific practical and generic transferable skills are learned and honed. The specific practical skills are likely to benefit students doing their research project in the final year: the potential effect of placement on project performance is the subject of another study. Quite often, a placement student undertakes a final-year research project in a completely different area to that experienced during their placement, although some laboratory skills will be generic. Therefore, it is more likely that the generic skills of team-working, communication, self-reliance and confidence, time keeping, etc., transfer to their approach to the project. Placement students may also benefit from seeing the practical applications of their studies outside the academic world and therefore relate to their studies with a greater insight.

Contribution of Work Supervisor

In exploring how work-placements might enhance academic performance, the contribution of the workplace supervisor needs to be considered. As Duignan (2002) puts it, the relationship between the employer and the academic tutor is asymmetrical in that the student is 'sold' to the employer as someone prepared academically for the workplace, but the employer does not undertake to return a student who is better equipped

for academic achievement. Any benefit that a student obtains from being on placement does not seem to result from anything deliberately planned by the employer; rather, the benefit may be due to the development of transferable skills that assist the student on placement and can be applied to academic studies on return to university, i.e. an incidental benefit. If the employers were to be made more aware of the opportunities to benefit subsequent academic study during the placement and if they were to know more about academic assessment, it might provide a means to make the placement year even more valuable.

Academics Sceptical of the Benefits of Work Experience

Some academics not associated with sandwich degree students are sceptical of the benefits of work-experience to the academic aspects of the degree. Furthermore, the attitude that a placement is a 'bolt-on', rather than an integral part of the programme of study is reinforced by offering degrees where the placement is optional and also by awarding the sandwich year notional credits that do not contribute to credit accumulation and degree classification. Parilla & Hesser (1998) found that, while most (USA) sociology degrees offer placements, academics are sceptical of the integrity of experience-based learning and of its impact on academic achievement.

Student Choice

As following a sandwich route appears to confer benefits, then arguably students need to be made aware of the academic advantages that contribute to improved employability. In a series of workshops run for students in the second year, we now inform them that placement students demonstrate improved academic performance compared with non-placement students. However, it is stressed that this is not a passive effect, but one that needs active input. On return from placement, we also run debriefing workshops in which we audit the transferable and specific skills students have gained and practised on placement, and help them apply these skills to the final year. These workshops have been introduced in the last two years and do not apply to the sample population in this study. Making placement students more aware that they can apply their skills to academic study may well assist them in improving their academic achievement.

Employability Prospects

It is possible that the general perception that students with work experience have improved employment prospects, evidenced by

previous studies such as that by Bowes & Harvey (2000), might be linked to the beneficial effects of sandwich placement on academic performance demonstrated in this study. Such improved employability may have two components: the separate benefit of the work experience, per se, in the eyes of potential employers (Harvey et al, 1997), and the improved chance of obtaining a better classification of degree through improved Level 3 performance demonstrated in this study.

Conclusion

In conclusion, for bioscience students undertaking a one-year placement, there is a demonstrable improvement in terms of their final-year mark that is independent of gender and earlier measures of performance.

Given that the improvement in Level 3 academic performance occurs within a placement programme not specifically designed to promote academic performance, it raises the interesting question as to the potential for improvement within a placement programme designed to provide tighter integration between academia and industry.

Acknowledgements

We would like to thank David Spiller for his help in obtaining the data for the sample population, and John Duignan for encouragement and helpful comment. This work was supported by the Fund for the Development of Teaching & Learning, Phase 4, from HEFCE.

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