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Undergraduate Research, Learning Gain and Equity: The Impact of Final Year Research Projects

Undergraduate research is seen as a 'high impact' practice that particularly benefits student engagement and leads to higher levels of achievement (Kuh, 2008; Laursen et al., 2010; Lopatto, 2009). Not only do scholars largely agree that this pedagogical approach achieves good outcomes, but there is also evidence that it particularly benefits students that are most at risk of underachieving (Egan et al., 2013).

This case study examines student achievement at a mid-sized UK university and compares student performance in undergraduate research across the sciences, social sciences, and humanities. The university enrols roughly 10,000 students in total, of whom two thirds are undergraduates. Almost all students across the humanities, social sciences, and sciences complete a yearlong project that counts for a quarter of their final year. This study examines students' grades for their final research projects to see if their performance improves or declines, relative to their performance in their other classes. This difference is analysed to evaluate the impact of other factors, including discipline of study, gender, ethnicity, family background, and previous academic performance. Results are analysed across five graduating cohorts, which provides a very large sample size of 5027 students in total.

Methods

This study evaluates the impact of undergraduate independent research projects (ISPs), which count for 25% of final year credits on these students' achievement, and what factors affect this impact. It analyses student grades for five annual cohorts of graduates from 2011 to 2016. Students' grades on their ISP module are compared to the average for their other final-year modules. The gain in grade between the ISP and the average of other classes, referred to as Research Gain, is used as the independent variable in a multiple regression to analyse the impact of these factors :

Prior Attainment:

Gender:

Ethnicity:

Disability

Low participation neighbourhood (LPN):

Discipline:

Year:

Previous research findings and controversies point towards a number of assumptions about undergraduate research and inform the following predictions:

(1) Research Gain will be positive

(2) Science Students will have a larger Research Gain than non-science students:

(3) Prior Attainment will have a negative impact on Research Gain:

(4) Low Participation Area will have a positive impact on Research Gain:

(5) Gender will have a positive impact on Research Gain:

(6) Black Ethnicity will have a positive impact on Research Gain:

(7) Asian Ethnicity will have a positive impact on Research Gain:

Results

Graduating students attained a mean mark of 61 across all modules in their final year. The difference between the grades for ISPs and the mean of all other final year classes was 1.21 with a standard deviation of 6.49, meaning students outperform their average class grade on the dissertation by 1.21 points on a 100 points grading scale.

[Table 1 near here]

The overall model results are significant at $p<.001$ with an adjusted R Square of 0.19.

[Table 2 near here]

Discussion

The descriptive statistics already indicated that the Research Gain is positive. The regression results show that six of the eight predictor variables returning statistically significant coefficients. These coefficients indicate the impact of each variable on the difference between the ISP module and the average of other final year modules on a 100 point grading scale, which makes it easier to interpret the size of impact for each variable. The 'science' variable was of most interest, returning a coefficient of .894, meaning that science students' research projects outperform their yearly average by

almost a full point more than students in the Humanities. Further, the significant, negative coefficient of -.554 for Social Sciences was not predicted and means that, while these students still get a higher average score on their research project compared to other classes, this improvement is much lower than other disciplines.

The findings for Prior Attainment returned a coefficient of -.085. That means that a student with a final year average of 50 would achieve a grade on their research project that outperforms their yearly average by .85 points more than a student with an average of 60. It clearly demonstrates that, while all students benefit on average from taking part in undergraduate research, students with lower academic grades benefit more from this experience than those with higher grades.

There was no prediction for Disability, but it has been associated with an achievement gap in higher education in the U.K. and U.S., so it was included as a control variable. It showed a significant negative impact on the higher grades associated with undergraduate research compared to other classes, with an average decrease of .528 point for students with disabilities.

The coefficient for female students was positive and significant. The size of the coefficient indicates that women improve on their research project grades relative to other grades .722 points more than men.

The results for Asian students, however, showed the largest impact of any variable. The coefficient was significant and negative, the opposite direction expected, contradicting Prediction 7. The size of the coefficient indicates that Asians improve on their research project grades relative to other grades .1.359 points less than for Whites. This result also contradicts research in the United States finding that ethnic minority students benefited more from undergraduate research compared to whites.

Conclusion

This analysis confirms previous research claiming that undergraduate research benefits students. In particular, it benefits students with lower academic achievement more than it does for students with higher grades. It also provides more benefits for women than men, and it benefits students in the sciences more than other disciplines. The finding of negative impacts for some minority students is the opposite result of most other research. There are clear limitations to this study. It analyses students from a single institution, though that can also be an advantage in the depth of detail it brings. However, the depth of the data provides an excellent means of analysing the impacts of other characteristics. The large sample size and ability to compare across disciplines using actual grades rather than reported benefits makes these results an important addition to this body of research.

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Table 1. : Descriptive Statistics and Sample Frequencies

	Mean	Standard Deviation
Research Gain (Overall)	1.2	6.5
Sciences	1.8	6.4
Social Sciences	0.5	7.8
Humanities	0.8	4.2
Prior Attainment	59.9	6.5
Disability	13.7%	
Low Participation Neighbourhood:	26.3%	
Gender		
Female	50.7%	
Male	49.2%	
Other	0.1%	
Ethnicity		
White	82.9%	
Black	5.4%	
Asian	11.1%	
Other	0.6%	
Discipline		
Sciences	43.2%	
Social Sciences	32.0%	

Humanities	24.8%

Table 2: The Effects of Student Characteristics and Discipline on Benefits from Undergraduate Research

	Unstandardised Coefficients		Standardised Coefficients			
Variables	B	Standard Error	Beta	t	Significance	
(Constant)	5.981	.834		7.169	.000	**
Sciences	.894	.231	.068	3.879	.000	**
Social Science	-.554	.247	-.040	-2.246	.025	*
Prior Attainment	-.085	.013	-.093	-6.373	.000	**
Disability	-.528	.266	-.028	-1.987	.047	*
Low Participation Area	.218	.207	.015	1.052	.293	
Female	.722	.186	.056	3.887	.000	**
Black	-.286	.410	-.010	-.699	.485	
Asian	-1.359	.298	-.066	-4.566	.000	**
Y2013	-.281	.283	-.017	-.991	.322	
Y2014	-.151	.279	-.010	-.540	.589	
Y2015	-.234	.291	-.014	-.804	.421	
Y2016	.198	.289	.012	.685	.494	

* p<.01; ** p<.001