

Descriptive Account

Reinforcing the Links Between Teaching and Research: Evaluation of a Scheme to Employ Undergraduate Students as Laboratory Assistants

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Abstract

A scheme was introduced to offer opportunities to second-year bioscience students to undertake part-time paid work in research laboratories. The aim was to provide students with a greater appreciation of bioscience research, to reinforce their laboratory skills and to encourage them to consider a research-based career. Students worked for 8 hours per week during term time and were paid at a minimal wage. Hours were negotiated with the supervisor to fit with the student's timetable commitments. The scheme has run for five years employing 74 undergraduates and we have undertaken an evaluation of its impact on students and staff.

Our findings indicate that the scheme has been well-received by students, with the overwhelming majority reporting that they enjoyed the experience, were well-supervised, and would recommend this scheme to friends. Students also reported a positive effect on their studies and that the experience had encouraged them to consider a career in research. Reports from supervisors were also highly positive. It is difficult to assess the impact of the scheme on students' career choices. However, where destinations are known, it appears that a relatively high proportion of students have opted for higher degrees.

Keywords: research-teaching nexus, laboratory skills, research culture

Background

In 2002 Newcastle University underwent a major restructuring of its Faculties and academic departments. During this exercise, members of staff from four existing small biological departments regrouped to form a School of Biomedical Sciences¹ within the Faculty of Medical Sciences. The new School had a cell and molecular bias and included a significant number of staff who had a research interest in the biomedical sciences.

This major restructuring was an opportunity to radically reorganize undergraduate as well as the research infrastructure within the new School. Inevitably, it also produced a number of difficulties, particularly in harmonizing research support. The development of dedicated career posts with responsibilities for undergraduate teaching at both academic and support staff level enabled the School to improve all aspects of undergraduate teaching but it was recognized that this could lead to some unwanted separation of undergraduate teaching and research activity. In addition, it became clear that a University scheme to introduce Research Institutes would eventually exacerbate this separation.

¹ This is the current name of the School; it was originally called the School of Cell and Molecular Biosciences.

The School of Biomedical Sciences' concerns over the need to link undergraduate teaching and research resonate with the Higher Education Academy's support of the belief that effective research-teaching relationships are highly beneficial for the student and fundamental to their development of an enquiring ethos (Jenkins *et al.*, 2007). The Academy has published two papers on linking research and teaching. The first (Jenkins and Healey, 2005) focused on institutional strategies and the second (Jenkins *et al.*, 2007) explored the links between research and teaching within disciplines. This paper describes a novel scheme that provides undergraduates with a working experience of research; it provides some practical information about the operation of the scheme and an evaluation of its impact on staff and students.

Introduction of Undergraduate Laboratory Assistants

In Newcastle four key factors led to the introduction of a system to employ second year undergraduate students as laboratory assistants in research laboratories². The first factor was the inability of the School to finance a dedicated research technician in each research laboratory. This was coupled with the fact that the School inherited a number of highly skilled research technicians and a plan that distributed these equitably among research laboratories would have resulted in each technician working for four laboratories. Both the academic and technical staff saw this arrangement as unworkable and it was felt that this would be detrimental to the career development of research technicians.

We were also concerned that research would increasingly become divorced from the undergraduate experience and as a consequence we would not encourage students to choose careers in scientific research. Since most academic staff in the new School came from 5* RAE 2001 Units of Assessment, this was seen as a serious short coming. The final factor was our knowledge that many of the undergraduates had part-time unskilled jobs in the city, often during antisocial hours.

This scheme, which employs students during term time, is different from Vacation Employment, where undergraduates are engaged, usually through scholarships, to contribute to ongoing research projects during the summer vacation. The project is complementary to vacation employment and has led to stimulation of interest in the latter and increases in the number of successful applications for Vacation Employment Scholarships (see below).

Details of the Programme

A senior technician was appointed to run the programme. This role involved managing recruitment of both laboratories and students, running an introductory session on safety and generic activities, such as the delivery system and waste disposal, together with monitoring student work sheets and total expenditure. This technician also liaises with HR regarding job descriptions, post requisitions and appointments as well as with the Finance Office regarding payments. The technician also serves as a contact external to the research laboratory should there be any problems.

The posts were graded at the lowest level (Level A) of the Technical Services Family and can be described as "providing support on simple and/or repetitive tasks within detailed instructions and under close supervision. The range of tasks performed is quite narrow and specific and involves little or no planning as work instructions specify what needs to be done, how it needs to be done and what equipment/machinery/tools to use"³. The work is quite different from the

² Students from across the spectrum of degree programmes run by the new School could apply (Biochemistry, Biochemistry with Immunology, Biomedical Sciences, Genetics, Human Genetics, Medical Microbiology and Immunology, Pharmacology, Physiology).

³ Hay Group Job Family Modeling (www.haygroup.com)

project based experimental research work carried out by third-year students as part of their degree programmes.

The job description can be summarized as follows:

Maintenance and Management of the Work Environment

- Operate common, standard, single purpose machinery/equipment in a simple or repetitive way
- Clean and tidy the laboratory
- Transport goods and equipment according to detailed instructions
- Inform Supervisor of stock levels for consumables/stores of basic equipment etc. in order to ensure availability to meet work requirements
- Adhere to basic health and safety procedures affecting self and others

Planning and Organising

- Perform simple, often repetitive tasks to appropriate time and quality requirements, following simple oral and/or written instruction.
- Work to detailed instructions under direct supervision, with tasks and
- work priorities being allocated to job holders by supervisor/manager.

Training and supervision is provided by experienced laboratory staff and the students learn basic safe working laboratory procedures and develop laboratory skills and scientific techniques practised in the research laboratory. The student provides assistance with a variety of tasks which include glassware/plastic sterilisation, media preparation/autoclaving, making simple solutions /buffers and basic sample preparation for analysis. Individual student levels of competency are monitored throughout the year and tasks allocated accordingly within the job description guidelines.

The students work eight hours per week. The specific hours are negotiated with the laboratory (usually an academic member of staff who is teaching on the student's degree programme) so that the work pattern covers the needs of the laboratory but also fits in with the student's timetable for classes and assignment deadlines. They are paid at point 1 on the single pay spine for Academic and HE support staff scale. Interestingly, when asked if they thought that the pay was appropriate, none said no and several said that the salary was more than they were paid in city jobs (e.g. in supermarkets).

In all years there have been more applications from both staff and students than funds could support. The Head of School selects the participating laboratories based on need and, as far as possible, providing help to new staff. The posts are advertised, and students apply and are recruited to individual laboratories. By negotiation, the supervising technician helps to ensure that no laboratory fails to recruit. The number of posts available has increased steadily from 11 in 2003 to 19 in 2007, sometimes through shared funding between the School and the individual laboratory.

All of the students worked in laboratories where postgraduate students and postdoctoral scientists were working and were therefore intimately exposed to both the science and teamwork within a busy research laboratory. The students also gained basic knowledge about equipment, an awareness of Health and Safety regulations and procedures, familiarity with standard office software packages, gained confidence in their ability to exchange information verbally or in writing as well as improve their practical skills including manual dexterity.

Evaluation of the Programme

The programme has now run for 5 years and we have undertaken a review of its impact on the students and the research laboratories. A total of 74 undergraduates have been employed. During the first 3 years, students were asked to complete a questionnaire during the final weeks of the programme and these graduates have recently been asked to re-evaluate the scheme. The current undergraduates (in years 2 and 3 of their studies) have also been asked to complete a questionnaire.

The response rate from undergraduates was 28/38 for the cohorts from 2003, 2004 and 2005 and 25/36 for the cohorts from 2006 and 2007. In the 38 students from the 2003, 2004, and 2005 cohorts, two students did not graduate, one was an exchange student and the other interrupted her studies due to ill health. The destinations of 30 of the 36 students who have graduated have been traced and 14 of these replied to the questionnaire.

Undergraduate Students' comments:

'I am in great support of the scheme. Thank you for introducing it. It is an excellent idea and was very well organised. Particular like how the scheme was ran during term time and its flexible hours.'

'Overall I am very happy with the placement, and really appreciate the opportunity to gain some work experience in the field I wish to pursue.'

'I did an industrial placement last year and at the interview I was able to talk about the work I was doing in the lab. This was a really good talking point as the job gave me valuable experience in the lab that I wasn't able to get any other way.'

With the single exception of one student who was neutral, all of the students said that they had enjoyed the experience of working in a research laboratory. In addition, all of the current undergraduates and the 14 responding graduates would recommend the job to a friend. The students also gave a unanimous yes, when asked if they received good supervision and support in the laboratory and there were only two students who were guarded about the School induction and support. The questionnaires primarily asked for a yes or no response but the students were told that comments would be welcome. There were a number of questions where undergraduates supplied comments but the question that prompted the most comments was "Did the experience have a positive or a negative effect on your studies?" With the exception of three students who were neutral, all students gave a positive response and, not surprisingly most of the comments related to practical components of degree programmes.

"Did the experience have a positive or a negative effect on your studies?"

'The experience had a positive effect on my studies. It in particular it encouraged me to spend more time in the medical school working in the library etc.'

'I gained a lot of practical experience so it was much easier for me to work during my lab sessions'

'Positive, really helped me to write an essay on a topic that wasn't covered in the lectures'

'The experience had mainly positive impact on my studies. The chance to learn about practical work really helped me in putting things into context later, and immensely boosted my confidence when working in lab. However, it may be that without the assistant job I might have concentrated a bit more on my studies, although it didn't really hinder me from doing anything.'

'Helped get a summer placement, helped understanding in the lab.'

'Definitely a positive effect, practical lab skills etc.'

'It helped with practical work'

'It meant that I didn't waste the time in between lectures as if I have an hour gap I can just nip to the lab'

'Positive, it gave me a lot of background knowledge and improved my practical work.'

A number of students commented that the experience had led to successful Vacation Studentship applications and felt that it was a very positive item on their CV. Only one student felt that time management had been a problem but a number commented on the benefits of flexibility in the work schedules.

Replies to the question (given to current undergraduates) "Do you think that the scheme strengthens the link between teaching and research?" were mixed with 60% saying 'yes' and 40% saying 'partly'.

'Students tend to think that lecturers are only there to teach. The scheme really taught me to understand how deeply involved in research our staff is.'

'Partly, if more students were involved it would be better'

'Partly, as I was only in contact with the leader of my lab and I also feel there is a good connection between teaching and research already anyway.'

'There are a few people on my course who also have a student lab position and we discuss our experiences with other students, this enables students to have a better understanding of the research being undertaken and how it affects our lectures.'

A comparison was made between replies to the question "Did the work experience encourage you to consider a career in scientific research?" given by students immediately after the work (2nd year undergraduates) and students from the same 3 cohorts after graduation. In the former 20/25 (80%) said yes and post graduation the positive response was 12/14 (86%). Of course, neither set of replies were complete and, in addition, it is possible that different students responded in each survey. In addition, most of the graduates who replied are postgraduate students (see below). The replies to other common questions were the same in this comparison.

Research laboratory support for the programme

Although there was general support for the introduction of the programme not all of the academic staff in the new School were in favour. In particular, a few senior members of academic staff would have preferred the funds available to be allocated to extra full-time career technical posts. Evaluation of the research laboratory attitudes was by interview. With one exception all of the participating laboratories have been enthusiastic and have continued to request student workers. One placement, which was considered unsatisfactory by the academic staff, involved a single student helping four different research groups. It is interesting, though, that the student, who has now graduated and is studying for a PhD, was very positive about the work experience.

Impact of the programme on final degree classification and career choices.

It is very difficult to evaluate the impact of the scheme on the participating students' academic performance since they form a self selected group. Table 1 below compares the average final year marks of the three cohorts of graduates with the average for the whole year group, and

this demonstrates small differences. Similarly, it is difficult to assess the impact of working in a research laboratory on the student's career choice partly because in general statistics on student employment post graduation are relatively thin. However, here the evidence of impact is stronger. Of the 30 graduates whose destination is known (out of a total of 36), 20 are studying for a PhD and one took an MRes. Data from the first destination survey of graduates for the period 2005–2007 show that 14.2% of 485 respondents were undertaking a research degree 6 months after graduating, so the figure of 67% for the graduates who had been laboratory assistants can be taken as a measure of the success of the programme in encouraging students to prepare for a research career ($p < 0.001$). Seven of the students who went straight into employment are working in science based jobs. For the two who have non-science jobs, one is in publishing and the other is on a graduate training scheme with the Audit Commission.

Table 1 Average final year marks. Numbers of students are given in brackets. The difference between these marks is not significant; t -test $p > 0.1$ that the marks come from a cohort with the same mean.

Year of Graduation	2005	2006	2007
Year group average final mark	62.4% (210)	63.3% (244)	64.3% (210)
Employed students average final mark	68.7% (11)	69.3% (12)	64.9% (16)

Postgraduate students' comments

'I would like to say that my experience as a laboratory assistant was perhaps the most useful part of my degree. It was extremely helpful for my third year project and attaining a summer studentship. This experience gave me the advantage and references that I needed to secure my PhD over many candidates who had higher academic qualifications. I am sure that the communication skills developed by interacting with people in the more professional sense would help any chosen career path.'

'It was only by chance that another one of my friends mentioned they were applying for the assistant scheme that I joined, and I am now very glad I did, I'd go as far to say that it really did shape the beginning of my decision to follow a career in research.'

'I was able to learn techniques and discuss theoretical issues that were not discussed in the lectures, but helped me later to make a decision whether to stay in a research based career'

'I have now started a PhD, encouraged by my experiences, and have recommended to current 1st years to take a lab position to get a better understanding of how the science they are taught works in practice, and also to give more insight into career decisions.'

Summary

It is acknowledged that one of the organisational impacts on Universities of the Higher Education Funding Council for England's Research Assessment Exercises (RAE), has been strategic decisions (taken in many universities) that have led to an increasing separation of top grade research activity and undergraduate teaching (McNay, 1999). The restructuring at Newcastle was also partly driven by this and the employment scheme described here is one approach that has been taken by the School of Biomedical Sciences to address a possible loss of the close research link with undergraduates that existed before restructuring.

Our findings indicate that, over a five-year period, the employment of undergraduates has been very well received by both students and research staff. In research laboratories it provided a

solution to the provision of basic technical support. However, one of the reasons for evaluating the effects of term-time employment of undergraduates in research laboratories was the possible negative impact that the job might have on student performance. This survey shows that in general, the scheme had a positive effect both on the students' learning experience and did not adversely affect their performance in assessed work. Despite caution associated with the self selection aspect of the scheme, the destination data and the graduate replies also demonstrate that the scheme has been a strong influence in students' decisions to take a postgraduate research degree.

A number of papers have been published that discuss the links between research and teaching. These are primarily concerned with the educational value of research in developing analytical and critical skills. The interpretation of the term 'research' varies considerably. Sears and Wood (2005) have surveyed links between teaching and research in the biosciences, emphasizing the experimental nature of these disciplines. Their paper presents 14 case studies and an appendix that outlines strategies for linking teaching and research at the level of module/course but many of these examples are 'paper' exercises.

The Newcastle scheme is extra-curricula; less structured than the Sears and Wood (2005) examples and does not include all students. In our view, with some financial ingenuity, the scheme could be expanded to include all students who want to participate but it would not benefit from being further formalised.

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References

- Jenkins, A. and Healey, M. (2005) *Institutional strategies to link teaching and research*. York: The Higher Education Academy: available from www.heacademy.ac.uk/resources/publications/papersandmonographs (accessed 31/07/2008)
- Jenkins, A. Healey, M. and Zetter, R. (2007) *Linking teaching and research in disciplines and departments*. York: The Higher Education Academy: available from www.heacademy.ac.uk/resources/publications/papersandmonographs (accessed 31/07/2008)
- McNay, I. (1999) The paradoxes of research assessment and funding, in Henkel, M. and Little, B. (eds.) *Changing relationships between higher education and the state* pp. 191–203. London: Jessica Kingsley Publishers
- Sears, H.J. and Wood, E.J. (2005) *Linking Teaching and Research in the Biosciences* Bioscience Education E-Journal, 5-4 available www.bioscience.heacademy.ac.uk/journal/vol5/beej-5-4.aspx (accessed 31/07/2008)