How do undergraduates benefit from Oxford's research strengths?

Oxford often expresses the view that the outstanding quality of its teaching is underpinned by the outstanding quality of its research. Such assertions have not always been accompanied by arguments or evidence that are convincing to outsiders. Reviews of undergraduate education in research-intensive universities in the USA have been sceptical about such assertions and the UK government and HEFCE are not currently convinced that benefits to undergraduate students automatically accrue from research strengths in general or from the special characteristics of learning and teaching at Oxbridge in particular. Currently available summaries of research evidence on the lack of a research-teaching link support government policy. Herb Marsh summarises this evidence in the first article below, and it challenges common assumptions. Elements of future funding for teaching, especially for Oxford and Cambridge, may depend on a more convincing public case being made concerning the benefits to student learning of Oxbridge’s unique strengths.

Evidence collected through a research study within Oxford by Keith Trigwell shows that students who report experiencing benefits from their teachers being active researchers gain better degrees and approach their studying in a more sophisticated way.

We are not the only university concerned about this issue. Around the world research-intensive universities are working hard to strengthen the research-teaching nexus through a wide variety of institutional strategies and teaching tactics. Alan Jenkins has over the past ten years familiarised himself with many of these efforts and made accounts available on web sites and through publications. Here he summarises some of the most interesting institutional efforts from the USA.

One such effort operates at MIT in the form of research opportunities for 80% of their undergraduates, often in their first or second year. Michael Bergren, Lydia Snover and Lori Breslow outline how this scheme operates. A number of UK universities now have formal schemes modelled on MIT’s and the research councils and bodies such as Nuffield are increasing funding to support such schemes. This is research funding being used to support undergraduate education so as to nurture future researchers, just as American research funding agencies commonly allow use of a proportion of research grants to provide undergraduate research opportunities.
Philip England describes how Earth Sciences at Oxford attempt to strengthen the research-teaching nexus through drawing students into their research community and Nigel Emptage describes how he has changed his tutorials to make his teaching more research-led.

This issue of Illuminatio is intended to stimulate debate about how to maximise the benefits to Oxford's students of its research strengths, and the final article by Graham Gibbs provides a conceptual framework intended to help distinguish between different approaches to this issue. During 2007 the Learning Institute will be working with subjects to document how they approach this issue and explore the rationales that underlie their practices.

Research-Teaching relations
Herbert W. Marsh, Department of Education

A positive research-teaching nexus should be a goal of all universities but empirical research provides little evidence that universities have been successful in achieving this.

Teaching and research are the most important activities of university academics. Here I look at the relationship between the effectiveness at these two activities and the implications for universities. Indeed, a positive nexus between teaching and research is fundamental to the rationale for universities. It may be more efficient to teach students in institutions without a research focus, and more efficient to conduct research in institutions without a teaching focus. Hence, the rationale, particularly for research-intensive universities, dictates that there are reciprocal benefits associated with teaching and research, each contributing to the effectiveness of the other. My interest in this issue was stimulated through my research on students' evaluations of university teaching. These evaluations are reliable, stable, relatively unbiased, and valid in relation to many criteria of effective teaching. In my research I contrasted opposing theoretical perspectives positing that teaching and research should be positively correlated, negatively correlated, or uncorrelated.

Teaching and research should be mutually reinforcing. Teachers who are active researchers are more likely to be on the cutting edge of their discipline, aware of international perspectives in their field, and convey a sense of excitement about their research and how it fits into a larger picture. The process of teaching forces academics to clarify the big picture into which their research specialization fits, clarifying their research and reinforcing research pursuits through sharing it with students.

However, it could also be argued that teaching and research are incompatible, for example, because unsatisfactory classroom performance might result from academics neglecting their teaching responsibilities in order to pursue research or simply because the two activities are fundamentally different. Also, the time and energy required to pursue one is limited by the time demands of the other, whereas the motivation and reward structures that support the two activities might be antagonistic as well.

John Hattie and I conducted a comprehensive meta-analysis of the relations between university teaching and research. Based on 58 journal articles reporting 498 correlations between teaching and research, the overall correlation was close to zero (r=0.06). We searched for mediators and moderators to this overall correlation, with little success. The overall conclusion of a near-zero relation found generalized across different academic disciplines, various measures of research output (e.g., quality, productivity, citations), alternative measures of teaching quality (student evaluation, peer ratings), and different types of university (liberal, research). We concluded that the common belief that research and teaching are inextricably entwined is an enduring myth. At best, research and teaching are loosely coupled.

Because of our belief that there should be a teaching-research nexus, we (Marsh & Hattie, 2002) pursued further research to better understand the relationships between teaching and research.
understand this nexus and how to reinforce it. Participants were from a major research university who had extensive data on teaching effectiveness and externally monitored research productivity over three years. They completed a detailed survey on teaching and research constructs (self-ratings of ability, satisfaction, personal goals, motivation, time spent, supporting activities, and beliefs in a nexus). We began by testing my theoretical model in which the near-zero relation between teaching and research outcomes is a function of the counterbalancing positive relation between teaching and research abilities and the negative relation between time required to be effective at teaching and research and, perhaps, the motivation to be a good researcher and a good teacher. We found only limited support for theoretical predictions.

Consistent with expectations, there were positive relations between research productivity, time spent on research, motivation to do research, and self-perceived research ability. For teaching, however, the picture was more complicated. In particular various aspects of time spent on teaching and teaching preparation were unrelated to teaching effectiveness, although self-perceived teaching ability was moderately related to teaching effectiveness. I surmised that academics might not know how to improve their teaching effectiveness so that additional time spent in preparation did not translate into better teaching.

In support of the posited antagonism between teaching and research, self-perceived research ability had negative effects on teaching motivation and time, whereas self-perceived teaching ability had negative effects on research motivation. However, there was no support for the fundamental assumption that the ability to be a good teacher and the ability to be a good researcher are positively related. Indeed, because self-ratings are likely to be positively biased by potential biases (e.g., halo effects), it was quite surprising that these self-rating variables were not positively correlated.

We also explored the belief that there is a nexus - that teaching contributes to research, or vice versa. Academics who believed that research contributes to teaching had more research publications and higher self-ratings of research. However, beliefs in this nexus had no relation to the corresponding measures of teaching. In contrast, the belief that teaching contributes to research was not significantly related to self-ratings or outcomes for either teaching or research. Even for academics who believed that there was a nexus, the relation between teaching and research effectiveness was close to zero. However, further research is needed on how emerging notions of scholarship relate to this nexus, and how the nexus is affected by increasing administrative loads and changing expectations of students.

My research showing that teaching and research are uncorrelated has also stimulated a fierce debate about the implications of these results. Particularly in the UK, the findings have been misinterpreted to mean that research and teaching functions of universities should be separated. However, a zero correlation does not imply such a separation - it means good teachers are no more or less likely to be productive researchers and that among productive researchers there are equal numbers of good and poor teachers. Indeed, a positive teaching-research nexus should be a goal of universities (to increase the number of academics who are both good teachers and good researchers), but empirical research provides little evidence that universities have been successful in doing so.

Herb Marsh is a Professor in the Department of Education at Oxford and is one of the most cited educational researchers in the world, especially concerning his work on evaluating university teaching.
Research-Learning relations
Keith Trigwell

Undergraduate students from the University of Oxford who say that their learning benefits from contact with active researchers in their colleges are likely also to describe an in-depth approach to learning and have a better degree classification on graduation.

The zero correlation between teaching (as evaluated by students) and research (as measured by indicators such as grants obtained and publications) reported in Herb Marsh’s article above does not mean that there are no relations between teaching and research. For a part of the sample the correlations will be positive and for another part they will be negative. There are different ways of conceiving of research that could have parallels with different ways of conceiving of teaching", and such relations have been found in empirical studies of active researchers who teach in areas similar to their research1.

But are relations between research and teaching important? Since teaching is principally the means to student learning, is not the relation between research and student learning the more appropriate focus of studies of this nexus?

In an attempt to address this issue at Oxford a total of 2,330 undergraduate students from 17 Oxford colleges returned a questionnaire with responses to items asking about their approaches to learning and the benefits they experience from contact with active researchers. The study was a part of a large-scale study of the student learning experience carried out at the University of Oxford2. 73% of students agreed or strongly agreed with the statement: I feel I benefit from being in contact with active researchers. The study was a part of a large-scale study of the student learning experience carried out at the University of Oxford2. 73% of students agreed or strongly agreed with the statement: I feel I benefit from being in contact with active researchers. The study was a part of a large-scale study of the student learning experience carried out at the University of Oxford2. 73% of students agreed or strongly agreed with the statement: I feel I benefit from being in contact with active researchers. The study was a part of a large-scale study of the student learning experience carried out at the University of Oxford2. 73% of students agreed or strongly agreed with the statement: I feel I benefit from being in contact with active researchers.

Each student was also asked to respond to a series of questions on their approaches to study. In adopting more of a deep approach to learning, students personally engage with learning in a way that leads to a meaningful understanding. This approach may appear to differ when adopted in different disciplines, but at the core of all deep approaches is an intention by the student to understand ideas and seek meaning. In adopting more of a surface approach, the students’ intention is to cope with, and meet requirements, particularly as they relate to assessment systems, without meaningful understanding9.

Students were also asked to indicate what they expected their degree result to be, and their actual degree result was obtained. The correlations between the extent to which they reported experiencing a benefit from contact with active researchers and their approach to learning and degree outcome are shown below.

Table 1 Correlations between students’ perceptions of their learning from contact with active researchers and their approach to learning and degree result.

<table>
<thead>
<tr>
<th>Deep approach</th>
<th>Surface approach</th>
<th>Expected Learning</th>
<th>Learning outcome*</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel I benefit from being in contact with active researchers</td>
<td>0.35</td>
<td>-0.25</td>
<td>0.15</td>
</tr>
</tbody>
</table>

N=2323, except * where n=745; all statistically significant at p<.001

The table shows that the students who feel they benefit most from contact with research-active teaching staff are also the students who adopt more of a deep approach and less of a surface approach to learning, and have a higher quality learning outcome as measured by both their predicted and actual degree result10.

For Oxford students this constitutes evidence of the student experience of a link between perceived research activity of their teachers and their own learning process and outcome.

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This relationship may or may not be mediated through teaching. Similar relations are found in other less research-intensive contexts, but correlations are not as high as at Oxford.¹¹

Keith Trigwell is Professor and Director of the Institute for Teaching and Learning at the University of Sydney. He undertook the research reported above when he was a Reader in the Oxford Learning Institute and Fellow of Kellogg.

Initiatives by US research universities to strengthen research-teaching relations

Alan Jenkins

There is currently a world-wide movement to strengthen the links between research and teaching with a particularly wide range of well-documented initiatives in research-intensive universities in the USA.

In the 1990’s the research elite in the USA were challenged by a series of reports to do a better job of making sure their undergraduates benefited from their research strengths. For example the Boyer Commission on Educating Undergraduates in the Research University¹² stated:

“The research universities have often failed, and continue to fail, their undergraduate populations. Thousands of students graduate without seeing the world-famous professors or tasting genuine research.”

Many research intensives have recently developed or expanded their ‘undergraduate research opportunity’ schemes in which selected undergraduate students work with faculty on research projects. This approach builds on what research intensives uniquely have – many high level researchers and resources such as research laboratories and libraries. The MIT scheme reported elsewhere in this issue of Illuminatio is the earliest and most developed example of this approach. There is growing research evidence of the positive impacts of these programmes on student intellectual development¹³, ¹⁴. This article summarises varied forms of research opportunities¹⁵ at US universities, with web links that provide more detail.

Undergraduate Research at the University of Michigan

At Michigan, in addition to ‘standard’ undergraduate research opportunities¹⁶ there are now a variety of versions addressing particular agendas, such as:

- The Arts of Citizenship¹⁷ where students and faculty research groups study issues of public concern with local community
- Undergraduate research projects to support academic integration and success at Michigan of Afro–American students¹⁸ from inner city Detroit. Evaluation has shown a marked impact on student retention and performance of the targeted groups.

Cross Disciplinary Team Research at Maryland

Student teams from engineering and other disciplines undertake three-year research projects in which they analyze and propose solutions to societal problems, which generally involve a significant technology focus such as:

- ‘A comparative study of erosion control measures in the Chesapeake Bay area and homeowner response to such interventions’. In their final year student teams present their research to experts in the field and write a team thesis.¹⁹

Year One Biology at Cornell

The ‘Explorations Program’ introduces biology first-year undergraduates to undertaking research. Staff have designed a range of small scale research projects using department research equipment and field research sites that introduce students to department research interests.²⁰

Southern History at the University of Virginia

A large history course with about 180 undergraduates is taught by a leading researcher on US Southern history. It involves undergraduate student teams using university archives to research a specific time or place and then publish their


¹² University of Stony Brook (1998) Re-inventing Undergraduate Education: Boyer Commission on Educating Undergraduates in the Research University http://www2.warwick.ac.uk/fac/soc/sociology/research/cetl/peop le/fellows/#jenkins


¹⁶ http://www.artsofcitizenship.umich.edu/


¹⁸ http://www.gemstone.umd.edu/

¹⁹ http://www2.warwick.ac.uk/fac/soc/sociology/research/cetl/peop le/fellows/#jenkins

²⁰ http://www2.warwick.ac.uk/fac/soc/sociology/research/cetl/peop le/fellows/#jenkins
Undergraduate research opportunities at MIT
Michael Bergren, Lydia Snover and Lori Breslow

84% of MIT’s undergraduates participate in research. There is growing evidence of positive impacts on many aspects of students’ education experience, on what they learn and on their future academic progress, both at MIT and at other universities that have established similar programmes.

MIT’s Undergraduate Research Opportunities Program (UROP) provides students with opportunities to work alongside faculty on intellectually robust, hands-on research. While UROP as a term has become part of the academic vernacular in the U.S., the name remains closely associated with the Massachusetts Institute of Technology, where UROP was launched in 1969. Formalized student-faculty research programmes are now offered in universities around the world.

UROP was founded by MIT’s first Dean for Undergraduate Education (a Professor of Physical Science) Dr. Margaret MacVicar. The idea of placing undergraduates in the laboratory was met, at first, with skepticism. Today, having students participate in research as junior colleagues to faculty is recognized as exemplary practice. In a prominent report on U.S. higher education the Boyer Commission\(^2\) called for “making research-based learning the standard in the research university.” The report goes on to say:

> Clearly the context of these and related interventions is in part particular to the United States in response to:

\(^1\) strong public criticism of research universities for neglecting undergraduate education;

\(^2\) competition for able students and their fees from prestigious liberal arts and science colleges;

\(^3\) ready availability of significant endowment income and large scale national research grants supporting undergraduate research from organisations such as the National Science Foundation\(^4\) and the Howard Hughes Medical Institute;

\(^4\) support from a national initiative that focuses on research education at research universities.\(^5\)

What is generalisable to other universities such as Oxford is the structured way these universities use their special facilities and resources and how they build on the resource of academically able and committed students. Instead of ad hoc opportunities being available to a few students, planned opportunities are offered to many. The planned opportunities are more visible, easier to fund and they add to the reputation of the universities and their attractiveness to prospective students.

Alan Jenkins is a Fellow of the Reinvention Centre for Undergraduate Research at Warwick and Oxford Brookes Universities. He is the co-author of Institutional Strategies to Link Teaching and Research\(^6\) and the forthcoming Linking Teaching and Research in Disciplines and Departments.

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By the senior year, the able undergraduate should be ready for research of the same character and approximately the same complexity as the first-year graduate student; the research university needs to make that zone of transition from senior to graduate student easy ... For those who do not enter graduate school, the abilities to identify, analyze, and resolve problems will be invaluable in professional life and in citizenship (p. 17).

Although UROP is not mandatory at MIT, 84% of the class of 2006 participated in at least one UROP during their undergraduate years. Approximately 50% of MIT faculty supervise UROP students. In a multi-university survey of graduating seniors administered by the Consortium on the Financing of Higher Education, MIT reported the highest number of students (53%) participating in faculty-led research when compared with its peer institutions27.

Students can enrol in UROP for credit (44% of the 2006 graduating class), pay (53%), or work on a voluntary basis (3%). Despite MIT’s primary focus on science and engineering, UROP opportunities are available in all disciplines, including the social sciences, humanities, management, and architecture. For example, in 2006, UROP students collaborated on cancer research being undertaken in chemistry, designed robotic systems in mechanical engineering, studied taxation issues in economics, and researched medieval engineering practices with the history faculty.

Although projects can entail one faculty member and one student working together, much like independent projects or dissertations, in most UROPs, students work within the laboratory setting and, perhaps more importantly, as part of a laboratory or research team. This means they get to observe first hand the practices, procedures, and interactions that commonly take place in the laboratory. Students are explicitly asked to participate in all phases of a standard research initiative, including developing a proposal, working at the bench, analyzing data, and presenting results both orally and in writing.

In the COFHE 2003 survey, students were asked to evaluate a number of possible effects of their UROP experience. Of all the outcomes listed, students rated the ability to gain a greater understanding of the research process most highly.

Fifty-eight percent of the respondents (n = 461) completed the statement ‘[UROP] helped me understand the nature of research and experimentation in a particular discipline’ with either ‘to a considerable extent’ or ‘to a very great extent’. This finding is reinforced by anecdotal comments made by MIT students and alumni. For example, Niel Robertson, who established the Meryl and Steward Robertson UROP Fund in honor of his parents, explained:

‘...UROP became almost like a retreat for me. It allowed me to go out and enjoy the guts of the subject’.

Additional analysis of the data in the COFHE 2003 survey by MIT’s Office of Institutional Research found that participation in research was positively associated with grade point average. That is, a larger share of students earning A’s (the highest grade in most American grading schemes) reported doing research than students earning B’s or lower 28 (see Figure 1).

‘...UROP became almost like a retreat for me. It allowed me to go out and enjoy the guts of the subject’.

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27 COFHE (2003)
Similarly, when asked to evaluate their undergraduate education, student researchers were more likely to evaluate that experience positively. Specifically, 43% of the COFHE respondents who participated in research judged their educational experience as ‘excellent’, compared to 36% of students who did not engage in research.

When educational researchers matched survey responses to demographic characteristics, they found no gender differences for overall research participation. However, men and women did rate specific outcomes of UROP participation (e.g., ‘got to know faculty’, ‘able to make or confirm a choice of major’) differently. As Figure 2 shows, for all but one of the six outcomes—‘got to know faculty as a result of UROP’—women reported higher results than men29.

This same analysis looked at the relationship between research participation and other educational experiences, including how often students said they involved in different academic experiences, how many hours per week they performed various activities, and the extent to which they said their skills and abilities had developed as a result of their undergraduate education. Controlling for gender, race, year in school, grade point average, and discipline, participation in research was found to be a positive, significant predictor of a number of educational activities and outcomes. Perhaps most importantly, students who participated in research were more likely to interact with faculty not only outside the classroom, but inside the classroom as well.

The preliminary research done at MIT mirrors several other studies that have found, for example, that undergraduate researchers are more likely to pursue additional research and graduate degrees30; report greater enhancement of important cognitive and personal skills and claim higher satisfaction with their undergraduate education31. In the upcoming academic year (2007-2008), educational researchers at MIT hope to undertake a study that delves more specifically into the effects of undergraduate research on such cognitive skills as the ability to pose questions, form problem statements, devise a research plan, analyze data, and present findings both orally and in writing, and to see if those capabilities extend beyond the UROP experience.

Michael Bergren is Assistant Dean, Academic and Research Initiatives, Lydia Snover is Director, Institutional Research, and Lori Breslow is the Director of the Teaching and Learning Laboratory, at the Massachusetts Institute of Technology.

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29 Snover et al. ibid.
There's more than one way of providing the 'Oxford experience'

Philip England

Earth Science students experience particularly informal social and working relationships with academics, rooted in the nature of field work, that gradually includes them into the scholarly community.

The core aspect of Oxford undergraduate teaching is close contact between the student and people engaged in research at the highest international level, and that contact is often identified with the traditional one-on-one or two-on-one tutorial. The purpose of this article is to describe the interactions within a small science department, and to suggest that there are additional routes towards the same quality of experience.

Earth Science is, to first order, not taught in schools, and most applicants to our undergraduate course have been attracted to the subject through their individual curiosity about some aspect of geology – earthquakes, volcanoes, evolution of life, and the origin of the solar system are common examples. The goal of our course is to give students the analytical and observational apparatus to convert that curiosity into an effective tool for investigation of the (always inextricably interlinked) physical, chemical, and biological processes that govern the evolution and present state of the planet upon which we live. When we discuss how we try to achieve this goal we rarely discuss teaching strategies or learning outcomes, because we regard the undergraduate experience as more akin to an apprenticeship than to four years of formal teaching.

Fieldwork is a central aspect of Geology and, almost irresistibly, it imposes a flavour upon our teaching. In a tutorial, even with the most able students, the tutor always has some element of control: topics can be specified, limits of discussion can be defined and, if all else fails, one can escape at the end of the hour. A day in the field typically involves more than 12 hours of close-contact teaching, in which the agenda is set by the observations that the students make, and the questions that they pose. Frequently, those questions have no known answer. Even if one wished to claim Olympian omniscience, that bubble would be pricked by the unexpected or inexplicable observation; there is no place to hide. The nature of field teaching forces the teacher to treat the experience as a collaborative enterprise in interpretation of the aftermath of Nature’s experiments, rather than as the transfer of received wisdom from the old to the young.

The informality engendered in field teaching cannot be erased or forgotten back in Oxford. By the time they are in their second year, most undergraduates are on first-name terms with the academic staff and, to a degree that I still find surprising after 20 years here, the apprentices and the mentors have an appreciation of each other as individuals. A variety of practices underpin this informality in ways that, separately, do not appear particularly powerful but which, because they are valued by all, have a large cumulative effect.

Interaction space is highly valued, and it is an (unwritten) guiding principle that anyone can interact with anyone else in the common space (library, staff coffee room, undergraduate common room, etc.) though, in practice, there is some stratification to this arrangement. Undergraduates tend not to feel entirely comfortable in the academic coffee lounge until their third or fourth years. Equally, academics do not presume on the undergraduate facilities, though I shall never forget being rescued, towards the end of a particularly awful day of administration, by an undergraduate whip-round that enabled me to raid their vending machine for the bar of chocolate that got me through the rest of the day.

Although I have emphasized the wide informal links between staff and undergraduates, it is nonetheless the case that ties between students and their college tutors remain strong. As I said at the beginning, Earth Sciences is a very diverse discipline, and undergraduates reflect the interests of their tutors to a greater degree than is explicable by pure chance. However, because the undergraduates know the personalities and interests of the academic staff they can make informed choices about the route through their education and by the time they embark on their 4th-year research project, they are usually grappling with a problem in which they have a close personal interest. We believe that an environment that minimizes the barriers between staff and students is essential if our students are to effect the transition from the memory-driven toils of A-level to free-standing members of the research community.

Philip England is Head of the Department of Earth Sciences and Fellow of Exeter. He undertakes research into aspects of tectonics.

Editorial comment

I asked Philip to write this short piece for two reasons. First, I was undertaking a study of research-intensive departments in world-class universities where the teaching is demonstrably outstanding, in order to try and understand how
Research-led teaching: The evolution of a tutorial style
Nigel Emptage

What the syllabus contains and what academics undertake research on do not always overlap, but this need not exclude a ‘research-led’ approach to tutorials.

Let me begin by saying that despite my clear appreciation of the importance of pedagogy I am a practitioner and no expert. I, and perhaps others that read this piece, arrived in Oxford rather ill-prepared for the task of tutorial teaching. In fact, I may have been exceptionally ill-prepared, as I had no formal teaching experience whatsoever.

Like many appointments mine was driven by the need to appoint research active individuals. I had of course been enthusiastic at the prospect of taking on teaching responsibilities and I had been particularly enchanted by the notion of ‘research-led teaching’. This to me had sounded wonderful. I could teach students about my field of work, and perhaps direct some of the brightest and best students into contact with leading scientists in a close-knit community with ample opportunity for students to meet them in an informal context and for students to be ‘exposed to wide ranging discussions and exchanges of ideas’. The earlier external TQA review made the same kind of observations. Earth Sciences has amongst the highest student ratings on a number of scales of the Oxford Student Course Experience Questionnaire. It is rated particularly highly as ‘intellectually stimulating’, as ‘stimulating interest in the field of study’ and as ‘motivating’. Student believe that they ‘benefit from being in contact with active researchers’ and both their ‘overall satisfaction’ and ‘satisfaction with the quality of support from the department’ are very high, especially compared with other science departments at Oxford. Ratings on the Oxford Postgraduate Research Experience Questionnaire are above the university average on every scale, with exceptionally high scores for the ‘quality of students’ research experience’, for their ‘supervision’ and for the ‘quality of services and facilities’.

Of ‘synaptic plasticity’ was not likely to add significant value to their education and less still to their performance in examinations.

In the first instance my solution to this problem was to forego ‘research-led teaching’ altogether and instead focus on teaching from the syllabus. I assembled a series of tutorials that would, I believed, supplement core course material. These tutorials were generally well received by the students as judged by a) the lack of complaints and b) examination performances that was at least consistent with those achieved by the students of my predecessor and so for several years I followed this path confident that I was doing my bit for the ‘Oxford tutorial’. In fact it was not until a radical change occurred in the format of the examination for the preclinical medics that I was confronted with the reality that ‘teaching led research’ might be the way forward. There was, however, a development in my thinking. Put simply, the material that I teach from the syllabus was once research! It may not be my research but nonetheless the way in which the work was conducted and the way in which the results were interpreted were in their way research. It may not be research! It may not be my research but nonetheless the way in which the work was conducted and the way in which the results were interpreted were in their way research. These tutorials and the research that they were based on were of course not new. In Oxford, Earth Sciences had a strong claim for being studied, on the basis of past reviews and teaching performance indicators of various kinds. The report of the most recent internal review of the department notes the way the programmes are ‘informed by the department’s strong research base’ and how it ‘brings students into contact with leading scientists in a close-knit community with ample opportunity for students to meet them in an informal context’ and for students to be ‘exposed to wide ranging discussions and exchanges of ideas’. The earlier external TQA review made the same kind of observations. Earth Sciences has amongst the highest student ratings on a number of scales of the Oxford Student Course Experience Questionnaire. It is rated particularly highly as ‘intellectually stimulating’, as ‘stimulating interest in the field of study’ and as ‘motivating’. Student believe that they ‘benefit from being in contact with active researchers’ and both their ‘overall satisfaction’ and ‘satisfaction with the quality of support from the department’ are very high, especially compared with other science departments at Oxford. Ratings on the Oxford Postgraduate Research Experience Questionnaire are above the university average on every scale, with exceptionally high scores for the ‘quality of students’ research experience’, for their ‘supervision’ and for the ‘quality of services and facilities’.

Second, during the study I undertook, it became clear that all the students and postgrads I met knew each other personally, regardless of seniority. They experienced ‘subject families’ in their colleges and they joined in coffee and tea, and beer on Fridays, in the department, mixing freely with academics and researchers. The central social space in the department has posters on the walls that have just come back from conferences, and which change regularly. It would not be possible for students to be unaware of what research was being undertaken or who was undertaking it. In this social space, informal discussion of research, with undergraduates involved, seemed to be going on constantly. Students were invited into research projects in the lab or the field in an ad hoc way if they showed interest. Students were being inducted into a ‘community of practice’ rather than only being taught, and there were blurred distinctions between teaching and research with everyone simply ‘doing geology’. This is the most striking example I have encountered of the link between research and teaching being one of joint engagement in shared scholarly activity within a supportive social environment, with students gradually being included in the community as junior members.
Alternative ways to maximise the benefits to students of research strengths
Graham Gibbs

The benefits to student learning of research strengths may be achieved in a wide variety of ways and these may differ markedly between disciplines.

Despite the clear evidence of a lack of an empirical relationship between excellent research and excellent teaching, there are strong beliefs amongst academics at Oxford that students do benefit from Oxford's research strengths. Listening to academics as they articulate how they think these benefits accrue it is clear that very different rationales are being described involving different kinds of benefit, many of which have little to do with whether the teacher is perceived as excellent as a teacher.

These different rationales relate to the inherent nature of different disciplines, but also to different teaching conventions and different priorities about what an Oxford education is for. What follows is an attempt to summarise a number of strategies so that individuals and subjects might consider which of them are currently most important in their own context, and perhaps how the research-teaching nexus could be strengthened. There is at present little empirical evidence that these strategies actually make teaching, or learning, better – though their use certainly makes teaching and learning different.

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1. Research informs the content of the curriculum and students are engaged because the knowledge is up to date and because teachers are more interesting when talking about the latest thinking in their field.

Active researchers introduce new courses and update existing courses so that the curriculum is constantly updated and topics are addressed afresh every time. This might be seen in frequently changing and updated special options and comprehensive overhauls of the curriculum from time to time, and in the extensive use of recent research in tutorials and lectures.

Dr. Nigel Emptage, above, found it difficult to use this strategy given the syllabus he was working to.

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2. Teachers who are active researchers have sophisticated conceptions of the nature of knowledge and the way it is created and how it develops, and this changes students' conceptions of knowledge and hence their approaches to learning.

This might be seen in the open-ended nature of assessment questions, the adoption of multiple perspectives on topics.
and the generally critical approach taken to all topics and questions. It might be less evident in assignments where there are “right” answers or in laboratory practicals that adopt routine methods to demonstrate predictable outcomes.

3 Research is undertaken within a disciplinary community of practice and students are inducted, as apprentice academics, into this community, almost regardless of the teaching. This might involve vertical integration with more experienced students such as with subject families within colleges, or doctoral students supervising third year undergraduate projects. This can change students’ identity to that of a member of the community, such as “a geologist” or “an historian” and this changed identity brings with it many changes in students’ approach to the subject. This could be especially true for graduate education where students can also be inducted into the international community of practice through conferences, networking, collaborations, peer review etc. It might be seen in frequent and close social and work contact between students and active researchers and the exploitation of many and varied opportunities for students to engage in the scholarly activity of the department. It might be less evident where students are dealt with in large groups, where students experience isolation, where there is limited use of communal spaces and where there are few opportunities for students to engage with scholarly activity in the department or college.

4 The most effective learning processes in a research environment are “authentic” in that they resemble the forms of academic practice, enquiry and peer review involved in research. This might involve students tackling genuine experiments rather than undertaking routine laboratory exercises, or producing an annotated bibliography rather than being given a reading list. It might involve forms of communication and audiences that are used in academic life, such as a book review for a designated journal rather than an essay. Students might be involved in peer review of each other’s assignments or projects. Active researchers are well placed to support authentic learning that involves enquiry. This might be evident in the degree of project work or problem based learning, and in conventional assignments being reformulated to resemble aspects of research. There are publicly documented examples in the UK of undergraduates editing e-journals, organising symposia, and of successive cohorts on a course building up sufficient scholarly material to publish a book.

5 Active researchers are best placed to teach research methodology and the use of research tools. A crucial aspect of disciplines is their research methodology and the research tools that are employed. Students may be taught experimental design, how to undertake literature searches, how to analyse data, how to undertake fieldwork etc. This might be evident in the inclusion of required research methods courses, the plentiful opportunity to practice the use of these methods and tools in assignments, and the assessment of research competence rather than only of subject knowledge.

6 Research-rich environments are characterised by the availability of superb learning resources, such as libraries, laboratories, museums and archives, that are very unlikely to be funded by teaching income alone. This may be supplemented by support for learning from specialist librarians, archivists, curators and specialist technicians, supplementary training in the use of special equipment or resources, and access to a wide range of specialist expertise from DPhil students and contract research staff, available to support undergraduate projects or specialist studies. On the National Student Survey Oxford has received the highest average rating on any questionnaire scale of any University, for “Learning Resources” (4.7 out of 5.0).

7 A distinctive function of research-intensive environments is stewardship of the discipline and the production of the next generation of academics. This can best be undertaken by those who themselves create and develop the discipline. This might be evident in the high proportion of students who go on to teaching the subject, to doctoral study and to research positions and academic careers.

8 It is not only original research, often termed the ‘scholarship of discovery’, that can support excellence in teaching. The ‘scholarship of integration’ can lead to the production of books and reviews of bodies of knowledge that provide conceptual overviews for students. Courses, lecture series and tutorials may be designed around academics’ textbooks or other extensive integration of material students would otherwise find dauntingly diffuse.

9 The ‘scholarship of application’ can provide examples and case material from consultancies and applied work that illustrate concepts being taught, engage students and help them to make the link between theory to practice.

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Over the coming year the Learning Institute will work with subjects to produce case study accounts of how benefits to undergraduates are believed to accrue through the design of courses and carrying out of teaching, in order to illustrate the different strategies and tactics currently employed.

**Graham Gibbs** is Director of the Oxford Learning Institute.