



**An investigation into the relationship between
research and teaching in science and engineering
departments: staff and student perspectives**

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Abstract

The complex relationship between research and teaching has been, and continues to be, the subject of much debate. This project examines the relationship in a small study of science and engineering disciplines from both the staff and student perspectives. It offers a preliminary insight into how the relationship is understood and interpreted.

Executive summary

1. Background

The complex relationships between research activity undertaken within institutions, and the student learning experience provided, have been, and continue to be, the subject of much discussion and debate at a national and international level. Although a close relationship between research and teaching is perceived by many to be beneficial to the student learning experience, previous research has shown that cultivating this relationship is in reality problematic. Evidence of the strength and character of this relationship remains limited.

If staff are to be encouraged and supported to align research and teaching expertise for the benefit of the student experience, more information will be needed on how this relationship can be facilitated and sustained at a departmental and practitioner level. The integration of research and teaching within an institution's strategic planning processes and support mechanisms requires careful management and needs to be actively encouraged, supported and facilitated in a systematic way if it is to be sustainable in the mid to long term and to complement other agendas. Building on this premise and the understanding that the research teaching relationship may differ from discipline to discipline, this project aimed to identify the existing and potential relationships between research and teaching at the departmental level in a group of six science and engineering departments. Building on previous research in this area, this project considers the debate from the perspectives of staff managing different aspects of their role and of students invited into the research community as learners. It does not dispute or challenge the established work in the field, but offers a preliminary insight into how the relationship is understood and interpreted by a particular group of students and staff working within their disciplines.

2. Aims

The project was carried out within six engineering and science departments and aimed to explore:

- how the research-teaching nexus is presently contextualised within the curriculum of these departments
- how the research-teaching nexus is encouraged, promoted and facilitated at the departmental level
- students' perceptions and understanding of the link between research and teaching within their own disciplines and its potential to impact on their motivation and learning experience.

The broad purpose of the project was two-fold: firstly, to increase awareness of the relationship between teaching and research at an individual, departmental and institutional level; secondly, to increase awareness of existing good practice in aligning research and teaching activities.

3. Methods

The departments selected as part of the project were varied with regard to their history at their institution, size and teaching profile. Some departments had been well established for several decades, others established more recently. Some were traditionally academic, others were more vocationally oriented. To ensure the project outcomes would be met, the following methodology was employed.

a) Literature review

A literature review was completed at the outset of the project to place it within the current knowledge and understanding of the research-teaching nexus and ensure that the project could draw on existing expertise and understanding.

b) Staff interviews

A series of structured interviews with academic staff were conducted. The interviews used a standard set of questions as a guiding framework leading to further discussion and investigation. The interviews provided an insight into the staff's personal experiences of linking research and teaching and the support received to do so. The interviews were analysed against the categories listed below.

- a. Interpretations of the relationships between research and teaching
- b. Individual practices
- c. Departmental approaches
- d. Evidence of a research community
- e. Student response

Structured interviews were conducted with six heads of department and 34 academic staff within the six departments. Staff interviewed held a variety of roles within the department. The variation in roles and responsibilities of the staff interviewed provided a broad picture of the relationship between research and teaching and helped to identify the consistency of experience and approaches of staff in a single department. This would also prove important in identifying whether certain approaches and interpretations of the relationship were consistent across disciplines.

c) Staff workshops

In addition to the structured interviews two half-day workshops were delivered to staff. The workshops were intended to focus on the different relationships between research and teaching and the potential impact on curriculum design at different levels. The sessions were facilitated and provided opportunities for both general discussions and small group work. During the sessions different experiences of the relationship between research and teaching were identified and discussed.

d) Student questionnaires and focus groups

Undergraduate and postgraduate students from participating departments were invited to take part in a questionnaire and focus group as part of the project, providing both quantitative and qualitative responses. Students were self-selecting, recruited through general email advertisements, a poster campaign and direct contact with departmental offices. Seventy undergraduate and postgraduate students overall were recruited to take part in the project.

Questionnaire

Students were asked to complete a short questionnaire designed by Mick Healey *et al.*, which had been used extremely successfully in previous studies.¹ The questionnaire was used to locate students' immediate and unprompted understanding of the research activities occurring in their department and the research activities they themselves had experienced to date. The topics addressed in the questionnaire included: how they were aware of research activity ongoing in their department and institution; whether or not they had taken part in a range of research activities; the experience they felt they had gained; and any perceived positive and negative impact on their learning experience.

Focus group

Undergraduate and postgraduate students were invited to participate in structured focus groups. These took place in an Innovation Lab. The i-Lab is a flexible and creative brainstorming environment, which provided an ideal setting to capture and explore student experiences. During the focus groups the students were asked to contribute to an anonymous brainstorming session. This sought to explore further the responses given to the questionnaire and to gain a deeper understanding of their knowledge of research, staff research in their department and the impact any departmental research has had on their student experience. During the focus group session the students were also asked to contribute to a small group discussion, which focused primarily on the concept of an academic community and their involvement within it.

The focus groups were organised by department, with at least two disciplines taking part at the same time. This approach worked extremely well providing students with an opportunity to compare their experiences and understanding with those from other departments, and a good dialogue resulted. The mixture of student groups also provided a form of peer support, which interpreted and explained terminology associated with research and teaching from one department to another. The sessions were conducted by an external facilitator and no member of academic staff was present during the sessions.

4. Conclusions

It is important to note that the project explored the link between research and teaching with a relatively small group of staff and students in each of the six departments in a particular institution. As a result, the conclusions are specific to this particular project and further studies would be required in order to identify any broader implications.

There was considerable consistency among the six departments with similar strategies cited repeatedly regardless of the particular science being studied. The departments were anonymised, and it was difficult to identify from the strategies adopted by staff which ones might be considered 'hard' or 'soft' sciences, a factor often taken into account in this debate.

Two departments adopted a structured and progressive model, providing students with opportunities to engage consistently in the research process throughout their studies and building the necessary levels of student confidence gradually. For one department this approach had been designed in part to satisfy the requirements of a

¹ Healey, M., Jordan, F., Pell, B. and Short, C., *The Research-Teaching Nexus: Student Experiences of Research and Consultancy* (in submission at time of writing).

professional body, but was felt to have been genuinely embraced by staff. For the other department, it had not been a deliberate approach, but rather had emerged from the innovative teaching practices of staff and a willingness to engage students fully in the discipline at every level. On the whole, staff in these two departments were confident that effective links were made between research and teaching activities. It is also interesting that taken individually many of the approaches used by these departments were also evident in the other departments, but were not necessarily implemented in a cohesive way and did not constitute a strategic approach.

From the questionnaires and interviews it was clear that there are very few dynamic links made between institutional and departmental strategic planning documents for research and teaching. In the majority of cases, the nature of the relationship between research and teaching was determined by individual practitioners. Although there was a considerable degree of consistency in the approaches taken by staff within each department, the absence of a clearly articulated strategy for linking research and teaching meant that it was not easy for departments to recognise or promote good practice more widely. The lack of a strategy also meant that it was difficult to establish appropriate boundaries, or to recognise constraints related to the discipline or curriculum within which staff could operate.

It was clear throughout the project that the language and terminology used to describe the relationship between research and teaching was problematic. The use of the 'nexus' and the different components of research-led/informed/based/oriented/tutored were felt to be confusing and distinctions between the different types of activity to be artificial. In addition, it was often difficult to distinguish activities linking research and teaching from good and effective teaching more generally, and the justification for doing so was thought to be unclear. For example, although during the course of the interviews staff were able to identify a range of approaches for using the latest research in their teaching, approaches that focused more on the process of research and equipping students with the skills to carry out research successfully were generally only teased out in discussion. Many staff did not immediately recognise these types of activities as evidence of linking research and teaching. Consequently it was difficult to identify all the incidences where research and teaching are linked, and many examples will have remained unacknowledged.

Some members of staff were aware of a renewed external focus on the relationship between research and teaching. Several members of staff thought that more explicit structures to support research and teaching would be helpful, although there was a concern that the introduction of such structures should not be overly bureaucratic and that further research would be needed to identify suitable approaches.

The experience of students was generally very positive; even those who were most forthcoming with ideas to improve practice were able to draw on numerous examples of research-linked teaching in their department. Students appreciated the quality of research expertise available to them during their studies. Staff enthusiasm for research was applauded and felt to be "*contagious*"; a motivating factor for students to engage with particular topics or pursue further study. The students interviewed recognised the value of the skills they had acquired through research-linked activities and in fact demonstrated them during the focus groups themselves. In the constant drive for improvement and increased student satisfaction, it is easy to overlook the distance travelled and neglect to acknowledge the high level of practice that is already widespread.

5. Recommendations

This research project investigated the links between research and teaching and how these are enacted and experienced from both staff and student perspectives. It was a small-scale investigation carried out in science and engineering departments within a specific institution and as a result the findings and conclusions may not be universally applicable to other institutions. Nonetheless, we have proposed a number of recommendations that may be of value to others.

1. A departmental framework for developing the dynamic link between the strategic planning documents for research and teaching should be developed and mainstreamed.
2. Dissemination of research should be accessible to undergraduate and postgraduate students with regard to both content and presentation. For example, joint research events between staff and students could be used to raise awareness of research projects and engender confidence in students to contribute to the research community within the department.
3. Research activity and the links with teaching should be more actively promoted to students and made explicit in learning outcomes and departmental literature.
4. Research skills should be developed as part of a structured and progressive approach during the period of study taking into account discipline variation where necessary.
5. Programmes of professional development for academic staff should include explicit training on how to develop effective links between research and teaching activities.

The creation of, and effective use of, shared physical space in a department should be used to cultivate an effective academic community that fully engages both staff and students in an open and mutually beneficial dialogue.

An investigation into the relationship between research and teaching in science and engineering departments: staff and student perspectives

1. Introduction

This report provides the findings from a small project funded by the Higher Education Academy, which investigated the nature of the relationship between research and teaching in six research-intensive science and engineering departments.

The complex relationships between research activity undertaken within institutions and the student learning experience provided have been, and continue to be, the subject of much discussion and debate. The recent inclusion of research-led teaching as a national priority in HEFCE's Teaching Quality Enhancement Strand 2006 will only serve to fuel this debate further as institutions are asked to define clearly the nature of the link, how it is sustained and how it impacts on the student experience they provide. This project, building on previous research in this area, considers the debate from within a small study of science and engineering disciplines from the perspectives of staff, managing different aspects of their role, and of students, invited into the research community as learners. It does not dispute or challenge the established work in the field, but offers an insight into how the relationship is understood, interpreted and enacted by a particular group of students and staff working within their disciplines.

1.1. Rationale

The nature of the relationship between teaching and research and its potential benefit for students and staff is currently being debated at a national and international level. However, evidence of the actual and perceived strength and character of this relationship remains limited. If staff are to be supported and encouraged to align research and teaching expertise more closely, more information is needed on how this relationship can be facilitated and sustained at a departmental and practitioner level. Building on recent understanding that the research-teaching relationship may differ from discipline to discipline, this project aimed to identify the existing relationships between research and teaching at the departmental level in a group of six research-intensive science and engineering departments. The departments selected were not restricted to a single discipline grouping, but rather varied in subject focus.

A close relationship between research and teaching is perceived by many to be beneficial to the student learning experience. Whether or not this is correct, previous research has shown that cultivating this relationship is in reality problematic. A dynamic and explicit link between research and teaching requires careful management if it is not to compromise other institutional agendas and be sustainable in the mid to long term.

1.2. Institutional context

The institution in which the research was undertaken is small in relation to its national competitors, with an undergraduate population of approximately 7,000, a postgraduate population of around 2,000 and a staff body of 2,000. It is also

relatively new, having been founded in the second half of the twentieth century. In spite of this, it is one of the UK's most internationally diverse institutions, while also having significant local and regional impact. The University has three campuses spanning the local region, but all of the departments that feature in the report are from its main and original campus, which also houses ten additional departments. A member of the 1994 Group, the institution is research-intensive, but teaching and knowledge transfer enjoy parity of esteem. In the most recent national Research Assessment Exercise, the University was highly placed for research and was also highly placed for the quality of its teaching.

2. Project aims

The project aimed to explore:

- how the research-teaching nexus is presently contextualised within the curriculum of six research-intensive science and engineering departments
- how the research-teaching nexus is encouraged, promoted and facilitated at the departmental level
- students' perceptions and experience of the link between research and teaching within their own departments and its potential to impact on their learning experience.

The broad purpose of the project was to increase:

- a) awareness of the relationship between teaching and research at an individual, departmental and institutional level
- b) awareness of existing good practice in aligning research and teaching activities.

3. Methodology

Using a combination of questionnaires, focus groups and structured interviews, the project gained a better insight into the ways in which staff in these departments bridge the space between research and teaching, and the extent to which students felt that they benefited from being part of a research-intensive department.

The departments selected as part of the project were varied with regard to their history at the institution, size and teaching profile. Some departments have been well established for several decades, others established more recently. A number of the departments would be considered traditionally academic, while others more vocationally oriented. A number of departments have to negotiate the requirements of a professional body.

To ensure the project outcomes would be met, the following methodology was employed.

3.1. Short literature review

A brief literature review was completed at the outset of the project to place it within the current knowledge and understanding of the research-teaching nexus in disciplines and to ensure that the project could draw on existing expertise and understanding. Several detailed literature reviews of the research-teaching nexus have been produced by previous studies, and the report is therefore focused on a particular aspect of the relationship.

3.2. Staff interviews

A series of structured interviews with academic staff were conducted. The interviews used a standard set of questions as a guiding framework leading to further discussion and investigation. The interviews provided an insight into the staff's personal experiences of linking research and teaching. The interviews were analysed against the categories listed below.

- f. Interpretations of the relationships between research and teaching
- g. Individual practices
- h. Departmental approaches
- i. Evidence of a research community
- j. Student response

Structured interviews were initially conducted with six heads of department and then with 34 academic staff within the six departments. There was an uneven number of staff interviewed in every department. This was partly accounted for by the size of the department, the competing demands on staff time and the time constraints of the project. Staff interviewed held a variety of roles within the department. The variation in roles and responsibilities of the staff interviewed provided a broad picture of the relationship between research and teaching and helped to identify any consistency of experience among staff in any one department as well as across the disciplines as a group. The breakdown of staff by academic title is provided in the table below.

Table1: Breakdown of staff by academic title

| Dept. | Academic title | | | | | | | Total no. |
|-------|----------------|--------|---------------------------|-----------------|------------------------|----------|-----------------|-----------|
| | Professor | Reader | Principal Teaching Fellow | Senior Lecturer | Senior Teaching Fellow | Lecturer | Teaching Fellow | |
| 1 | 1 | | | 1 | | 1 | | 3 |
| 2 | 1 | | 1 | | | 7 | | 9 |
| 3 | 1 | 3 | | | 3 | 1 | | 8 |
| 4 | 1 | 1 | | 1 | | | 1 | 4 |
| 5 | 3 | | | 1 | | 1 | | 5 |
| 6 | 1 | | | 2 | | 2 | | 5 |

3.3. Staff workshops

In addition to the structured interviews and focus groups, two half-day workshops were delivered to staff. The workshops were intended to focus on the different relationships between research and teaching and the potential impact on curriculum

design at different levels. The sessions were facilitated and provided opportunities for both general discussions and small group work. During the sessions different experiences of the relationship between research and teaching were identified and discussed.

3.4. Student questionnaires and focus groups

Undergraduate and postgraduate students from participating departments were invited to take part in a questionnaire and focus group as part of the project, providing both quantitative and qualitative responses. Students were self-selecting, recruited through general email advertisements, a poster campaign and direct contact with departmental offices. There was a good response with 70 students recruited. There was an uneven spread among the six departments, and while the precise reasons for this are unknown it could be at least partly accounted for by the corresponding size of the departments. Although the number of students was quite small, it was still felt to be a reasonable number and would allow for more detailed discussion in manageable focus groups. With the exception of one department, which has a larger postgraduate community, there was a deliberate bias towards undergraduates as it is with this group that understanding is more limited.

Table 2: Breakdown of students by status

| Department | Number of undergraduate students | Number of postgraduate students |
|------------|----------------------------------|---------------------------------|
| 1 | 4 | 4 |
| 2 | 11 | 5 |
| 3 | 8 | 3 |
| 4 | 16 | 4 |
| 5 | 8 | 3 |
| 6 | 5 | 5 |

3.4.1. Questionnaire

Students were asked to complete a short questionnaire designed by Mick Healey *et al.* (in submission), which had been used extremely successfully in previous studies.² The questionnaire was used to locate students' immediate and unprompted understanding of the research activities occurring in their department and the research activities they themselves had experience of to date. The topics addressed in the questionnaire included: how they were aware of research activity ongoing in their department and institution; whether or not they had taken part in a range of research activities; the experience they felt they had gained; and any positive and negative impact on their learning experience.

3.4.2. Focus group

The students were asked also to participate in a structured focus group, which took place in an Innovation Lab. The i-Lab is a flexible and creative brainstorming environment, which provided an ideal setting to capture and explore student experiences. The focus groups were organised by department. The sessions were conducted by an external facilitator and no member of academic staff was present during the focus groups. These sessions were considered extremely valuable in

² The questionnaire is included in Appendix A.

gaining a deeper understanding of student knowledge of research, staff research in their department and the impact any departmental research has had on their student experience.

Students were engaged in an anonymous online brainstorming session. The initial questionnaire was used as an early prompt for discussion, and a series of further questions explored topics in more detail. Within the anonymous format students were able to comment on the responses from other students in the group and to ask each other questions. A good dialogue between students from departments took place. Students freely discussed their understanding of research with each other, and many groups were confident questioning and explaining terminology among themselves. Although students were anonymous they identified themselves as being postgraduate or undergraduate in their comments.

The focus group session also included a small group discussion, which focused primarily on the students' sense of an academic community and student experience of engaging in such a community in their department, at any level. For this part of the session students were grouped according to department and by undergraduate and postgraduate.

4. Short literature summary

Seeking clarity of the complex concepts of research and teaching and their possible co-relation within a learning community, whether discipline-specific or institutional, has rightly been the subject of much research, and there is a substantial body of knowledge and expertise on which to draw. Previous research has varied in scope and approach, examining the correlation in whatever form it exists, through the eyes of individual staff, related or opposing discipline groupings and organisational structures. The construction of the 'nexus' with its different components provides a common framework from which to identify and distinguish incidences of research-linked teaching (Healey, 2005). However, the 'nexus' is not a language that is widely used by academic staff, and many links between research and teaching inevitably remain hidden.²

From some perspectives research and teaching are considered to be separate spaces, equally important but nonetheless separate, and any dynamic relationship between the two, particularly at the undergraduate level, becomes improbable and at best manufactured (Rowland, 2005). From other perspectives it is the organisational structures and policies that restrict the number of occasions that research and teaching have to meet. The competing demands on staff time, the rewards particular types of research deliver, and the potentially divisive labeling of staff as research and non-research active all compound the difficulties of actively linking research and teaching. Add to this congestion of the curriculum, or the demands of external drivers, and links between research and teaching can easily become exposed and undermined.

Recently the work of Healey and Jenkins has shifted the focus of the debate to the discipline. In his recent research on disciplinary spaces and inquiry-based learning Healey argues that in trying to decipher the "complexity and contested nature of the linkages between research and teaching" the discipline becomes an "important

² The nexus is currently the subject of a Higher Education Academy research project entitled *Tribes, territories, research and teaching: enhancing the teaching-research nexus*, led by Paul Trowler, University of Lancaster.

mediator” (Healey, 2005; Jenkins *et al.*, 2007). It is in the disciplinary cultures where research takes place, he argues, that understandings of research and teaching are conceptualised. It is inevitable that understanding of research will be constructed within the paradigm of a particular discipline and to an extent inherited from previous generations of researchers, thereby forging a shared language and vision, or, as Robertson and Bond (2001) suggest, following the “rhythm and pace to learning that is an integral part of the architecture of a discipline.” Reasonable parameters for the research-teaching relation in disciplines therefore need to be established, observed and shared by those within and outside the discipline community. There may be considerable similarity between these parameters, but it is only by coming to a shared understanding of the varying nature of the relationships that they can be fully understood.

In *Linking teaching and research in disciplines and departments*, Jenkins, Healey and Zetter (2007, p.13) argue that we need to recognise “the complexity and varied meanings that we individually and collectively understand by the term research”. This is fundamental to understanding how the two can be linked. Brew has suggested that relationships between teaching and research are dynamic and context driven and therefore dependent upon “whether research is seen as an objective product or a process of enquiry and whether teaching is seen as a transmission of what is known or an exploration”.³ The categorisation of the research-teaching relation as weak, transmissive, hybrid or symbiotic by Robertson and Bond (2005b, p.82) is helpful. Colbeck argues that the “broader and more inclusive the definition of what counts as research the easier it is to integrate it with teaching”.⁴ If this is the case, it becomes difficult to distinguish research-linked teaching from simply effective teaching.

There has been an often unstated assumption that the relationship between research and teaching is most apparent and, to an extent, expected at the postgraduate level, where the research activity of the students becomes a defining quality. Specialist options or postgraduate study are frequently aligned with an individual academic’s own research area, and hence the bridge needed between the two spaces is shorter. At undergraduate level, particularly in years one and two, it is possible that students may lack the knowledge, skills and ability to engage in the type of enquiry that would be recognised as research in its narrowest form. This problem has been associated with science disciplines in particular, but equipping undergraduate students with the skills required to actively engage with research at a level of originality is a challenge that staff in the humanities and social sciences would also face (Jensen, 1988). Staff-student research collaborations can also be constrained by ethical, practical and financial factors. However, the broader and more inclusive definitions of research enable students to engage in the processes of research and increase their contributions gradually over time.

The role of professional bodies is another factor that has a bearing on the relationship between research and teaching. Webster (2002) refers to the encroachment of professional bodies on the curriculum with expectations linked to accreditation requirements, often a key significance in student recruitment. This may, as Jenkins suggests, obstruct the link, but it can also help to foster it. For example, for a degree programme in Psychology to be accredited by the British Psychological Society the department must satisfy the Society that it provides appropriate opportunities for students to conduct research projects and develop research skills. This will have a substantial impact on the design of a programme;

³ Brew, A. cited in (Jenkins *et al.*, 2003), p.14.

⁴ Colbeck, C.L. 1988, cited in (Healey, 2005), p.71.

however, it is equally possible that this expectation and approach to curriculum design and delivery then becomes a shared boundary by staff in the discipline and eventually part of the 'rhythm and pace' that is understood.

The student voice has been heard in several studies of the research-teaching relationship, focusing in the main on students' understanding of the term 'research' and their experience of different approaches. Most recently Angela Brew (2007) has identified a need to consider the student voice in the context of theories of learning and organisational management. Barbara Zamorski's (2003a) study of third-year undergraduates and their experience of research-linked teaching identified how students can be actively engaged in staff research collaborations, with students not seen merely as a captive 'audience'.

Despite many inhibiting factors it would seem that relationships between research and teaching survive and operate successfully in many guises, borne out by the many case studies of individual practice (Jenkins *et al.*, 2007; Healey and Jenkins, 2007). These case studies are evident across undergraduate and postgraduate level. When an awareness of the discipline boundaries is taken into account, it can provide a clearer insight into how the relationship between research and teaching can be manifested in different departments, whether or not the organisational structures of the institution are traditionally supportive. This is key to understanding not only the relationship itself, but also the mechanisms that may be needed to facilitate a more beneficial relationship, particularly if that relationship is to be *mutually* beneficial (Rowland, 2000). It also clearly identifies the parameters of reasonable expectations, within which all staff can operate.

The relationship between research and teaching is two-sided, and it is therefore equally important to explore the concept of teaching and the role of the academic as a teacher. Many studies have shown that there is often a strong belief among academic staff that involvement in research bears a direct and positive correlation to high quality teaching, and this pattern has also been evident in this small study (Robertson and Bond, 2005a). However, there is no convincing evidence to support this claim (Hattie and Marsh, 1996). The roles of researcher and teacher are not symbiotic, and there is no evidence that being excellent in research automatically translates into excellence in teaching. Wider research into aspects of learning, teaching and assessment, and an understanding of how students learn, emphasises the need for teachers to create more opportunities for students to develop and apply knowledge and skills. This is encouraged irrespective of the discipline. Some teachers will do this instinctively, whereas others will develop the skills through continuing professional development as they gain a better understanding of the way students learn. It is clear that someone actively researching in a particular field will be more informed than someone who is not researching in that field, but this does not mean that the researcher will be able to convey the knowledge and skills more effectively. A more interesting debate is the extent to which working in a research-rich environment will provide opportunities and expectations for all staff to distil what is current and convey that to students beyond their own area of expertise.

As always when the medium is human, there are unknown quantities that will affect the presence, strength and quality of the relationship. An unknown quantity remains whether being research active enables someone to make leaps that others might not see and move teaching forward. Therein lies the difficulty for any study in the relationship between research and teaching.

5. Findings and results

As stated earlier, the project aimed to explore how the research-teaching nexus is presently contextualised within the curriculum of six research-intensive science and engineering departments and students' perceptions and experience of the link between research and teaching. The following section provides the results from:

- a) a structured interview process with 34 staff from six departments of science and engineering
- b) a questionnaire and series of focus groups with 70 students from six departments of science and engineering.

Throughout the report the departments are referred to by the numbers 1 to 6 rather than by discipline title and comments are not attributed to individuals. Student responses to questionnaires are provided in Appendix 1.

5.1. Department 1

Department 1 is a small department with an established reputation for research and teaching excellence. The department offers a range of undergraduate degree schemes, and at postgraduate level has a long history of providing taught courses and supervising projects for advanced research degrees. The department takes great pride in its excellent staff-student relations.

5.1.1. Staff perspectives

Although very few members of staff used the language of the nexus, they all believed that they were able to make links between their roles as researcher and teacher, irrespective of the particular subject matter being taught. There were several factors influencing the nature of the link relating to the level of study, the requirements of the curriculum and to a lesser degree student confidence, motivation and engagement. The distilling of what is current was felt by many to be an essential aspect of the university student experience and was believed to be possible at every level of study. The acquisition and application of research skills by students was recognised by staff as being a key link between research and teaching; however, this was considered to be more implicit and not easily identifiable during the early undergraduate years. The specific nature of research in the discipline limited the number of opportunities to integrate research-based activities in the curriculum in the early undergraduate years, but this was much more visible in later years and postgraduate study.

During the first- and second-year undergraduate years, there was a strong emphasis during lectures and classes on raising students' awareness of the current research and latest techniques in the discipline and providing opportunities for students to discuss new research in both formal and informal settings. For example, one approach was to explain a modern research problem in a lecture and ask students to contribute to it via a purposely set up discussion forum. Other strategies focused more on engaging students in practical aspects of research, with research methods integrated in teaching where appropriate to the task. For example, as well as the larger project-type activities, staff described how they discuss their own research results with students and help them to analyse the data and draw conclusions for themselves. At the end of the final-year project the findings are presented to fellow students, providing an opportunity for students to learn about other projects, approaches and methods. One member of staff felt that their students benefit enormously from being part of a larger research group and contributing to research

projects within the group: *“It is very easy for students to pick up small parts of a research project to fill a knowledge gap.”*

Although staff had experience of linking the two roles at every level of study, the connection was felt to be most advanced and visible in second- and third-year undergraduate courses and at postgraduate level, where the research interests of staff could be most clearly aligned with the courses taught and, perhaps more importantly, where it was felt that students had had sufficient time and opportunity to develop the required level of research skills and confidence to fully engage.

On the whole, the links between research and teaching were not prescribed by the department, but designed and managed by the individual member of staff in response to their particular teaching responsibilities and student cohort. Standard quality assurance mechanisms are used to evaluate and reflect on existing provision within the department, but such processes consider the student experience as a whole and the relationship between research and teaching is not an explicit component of these processes. None of the members of staff interviewed were aware of a clearly articulated links between research and teaching in the department’s strategic planning documents. However, two specific strategies were stated repeatedly: optional courses are aligned with staff research interests enabling students to benefit directly from the wealth of national and international expertise in the department, often in niche areas; and third-year undergraduate projects are closely aligned with staff research interests, with a deliberately flexible and collaborative management process in place. It was felt that enabling staff to decide how best to integrate research activities in their courses rather than following a particular model was effective. The staff interviewed provided many examples of designing and redesigning teaching activities to maximise the links wherever possible and to meet the different needs of student groups at different stages of their study.

Where staff had integrated research activity in the curriculum, it had been met with a mixed response from students, with some very engaged, while others were less motivated by this approach. This was attributed in differing degrees to the level of difficulty of the topic, the particular activity or teaching approaches adopted and the dynamic of different cohorts. The experience of some members of staff was that it was sometimes difficult to strike the right balance between covering the undergraduate curriculum and introducing elements of research, particularly if they were not to risk losing students’ attention or damaging confidence. The experience of other members of staff was that it is often difficult for first- and second-year students to follow complex research concepts and as a result some members of staff had, on occasion, decided to remove or reduce some research elements and activities from courses. Approaches are continually reviewed and revised to ensure that they remain appropriate for the students in any one group.

As expected, staff were passionate about research within their discipline and many were actively engaged in discipline networks, research projects and research collaborations. The department has developed a supportive research environment for staff, with several specialist research groups meeting regularly and a research seminar programme of internal and external speakers showcasing latest research. Students are invited into this research community in a number of ways. New projects, seminars and points of interest are displayed within the department and advertised widely to ensure that as a minimum, students are aware of research activity in the department. Students have access to staff publications and presentations, and there is an open invitation to students to attend the research seminars, many being actively encouraged to do so if it is relevant to their studies.

A second strand to the departmental research seminar programme has also been recently developed, which complements the more formal series of internal and external speakers on niche areas in the discipline. Sessions are held on more general research topics, which are given informally and have been purposefully designed to engage students and encourage more interaction between students and staff on research topics at an accessible level. A series of student problem-based competitions also take place in the department, which are open to all undergraduates and help to make connections between research and its application. Students are strongly encouraged to use the shared space in the department, increasing the opportunities for staff and students to meet unplanned. Together these mechanisms are used to cultivate a sense of academic community within the department and provide opportunities for informal exchanges between staff and students.

Student involvement in, and awareness of, the research community in the department was felt to be strongest in the third year and at postgraduate level, when student participation was more evident. Involvement at first- and second-year undergraduate levels was felt to be less consistent and dependent upon individual students' motivation. A number of staff felt that while it is always difficult to actively engage undergraduate students in events such as research seminars because of the level of material, they also recognised the different needs, expectations and priorities of students. There are many demands on students' time and sustained engagement in research-related activities outside of the course is not necessarily a priority for all.

5.1.2. Student perspectives

In total eight students participated in the study: four postgraduate and four undergraduate.

The participating students were generally aware of the range of research being undertaken within their university, which they felt was widely promoted through seminars and conferences, advertisements for research opportunities, exhibitions and displays and different research publications by members of staff. Students were also aware that specialist research units existed within the University, although they were less knowledgeable about their remit or reputation for excellence. There was a general awareness of the research activity and reputation within the department, although detailed knowledge of specific research interests or externally funded projects varied between the students. Student participation in staff research was typically associated with third-year undergraduate and postgraduate levels.

Students' understanding of the term 'research' in the context of their discipline moved between two established definitions. Some students interpreted research as the discovery of new and original material, which was often characterised as "*taking an idea and developing that idea*" or "*looking into something new*". For these students there was a shared emphasis on research as an independent activity whatever the level: "*looking for a specific topic on your own*"; "*working in your own time with limited input from a lecture*"; "*a specific area which is of interest to yourself*". For other students research was concerned with acquiring a detailed knowledge of a particular area in order to improve their understanding: "*research is very valuable because it lets you understand a specific topic in science more. I think it is important to know how you get the results they teach us.*" However, there seemed to be no immediate connection between the particular interpretation of 'research' and the level of study.

Most students had a good understanding of the ways in which research and teaching could be linked, that included not only the teaching of specialist modules linked to research, but also the use of research techniques and processes to build confidence,

knowledge and understanding. Some students suggested that research can be *“integrated through the teaching process to help people understand the topics better”* or linked to small-scale independent projects that encourage *“students to learn through their own methods”*. Several students emphasised a collaborative approach as being particularly effective, *“where the student idea is a part of the teaching process”*, or the lecturer acts as a guide, steering the student towards reading materials, but allowing the direction of the project to be the student’s choice. Although some students commented that they *“learnt about [research] almost immediately into my degree, independent work is a large focus in the department, going away and developing and understanding key ideas and theories”*, there was also an awareness of the limitations placed by the discipline. This is particularly evident in the following undergraduate comment: *“most things that we have studied have been set in stone for years and there is no ‘wiggle room’ on researching them”*.

Both postgraduate and undergraduate students felt that they had very much benefited from research-related activities being embedded in their experience from the first-year undergraduate level onwards, with many feeling that they had acquired a significant number of new skills as a result. Activities such as reading research reports, attending seminars, hearing members of staff talk about their research in lectures or participating as subjects in experiments had been consolidated by small-scale research projects, dissertations or theses. In addition to the skills typically associated with these types of research activities such as presentation skills, time management, analysis and synthesis of data, students also identified a number of other transferable and confidence-building skills. These included: *“self-motivation”*; *“interesting to challenge my own ideas and opinions by reading other people’s views”*; *“classroom knowledge is transformed into reality”*; *“taking my project in my own direction”*; *“understanding how my study impacts on the real world”*; *“having the discipline to work by yourself and develop your own ideas”*; and *“you have and can develop your own ideas, you don’t just take what other people say”*.

During the focus group session, students were asked specifically if their experience of research has motivated them to consider further postgraduate studies. For the majority of the students their experiences of research have had a positive influence and had made them consider further studies in their discipline or pursuing a career involving research. Comments such as *“Career involving research is very interesting”*, *“spurred my interest in further research”* and *“Yes, on the topic studied, because I can take the research further”* were common. Understandably, however, not all students were enthusiastic about research that was associated with an in-depth knowledge of the subject: *“research seems really boring unless you are REALLY passionate about the subject”*. Involvement in research was not seen exclusively as being about professional development, but instead had also prompted a more general personal interest. This is alluded to in the following undergraduate comment: *“Hearing from lecturers there seems to be a LOT of time and effort going into publishing a paper. Personal research seems to be more beneficial unless you have a real urge to contribute to the research community.”*

The students very much recognised the existence of a research community and culture within their department and identified a number of benefits to the student experience. These included: *“encourages learning”*; *“enables better understanding”*; *“helps build enthusiasm”*; *“enables students to work through problems with members of staff”*; and *“provides a bigger support network”*. However, it was generally agreed that outside of formal teaching situations access to the research community was only really possible at a postgraduate level. The students recognised that the access to some aspects, such as the research seminars, was limited because of the level at which they were pitched. However, they were very keen to explore possible

solutions. For example, they suggested holding weekly meetings where members of staff can meet with students and discuss their research interests, discuss project ideas and share interests that are outside the curriculum. Some students felt that even more attention could be drawn to the research achievements of staff by creating more accessible and detailed staff research profiles. Other students felt that more creative use should be made of the shared space in the department; for example, to host networking activities or to provide discussion space following the submission of coursework. These types of exchange could be between undergraduates, postgraduates and staff, providing a departmental forum for students to ask other students for help not just the lecturers, provide different viewpoints and opinions and identify shared research interests. This sense of continuity from undergraduate and postgraduate could be influential in engendering a genuine sense of community and awareness of research activity beyond course requirements. For example, one student who had gone on to study at postgraduate level commented: *“during my undergraduate days some postgraduates were always talking about their research work”*.

5.2. Department 2

Department 2 is a large department with over 700 students choosing to study across a very broad spectrum of subject areas. The department has an established reputation for teaching and research excellence as evidenced by its performance in the QAA and RAE processes. The department has grown considerably over the last decade with several specialist areas and centres of activity established.

5.2.1. Staff perspectives

Every member of staff interviewed believed that they were able to make positive links between research and teaching, with some members of staff being strong advocates for linking the two activities. There was a general assumption that the discipline was founded on, and is sustained through, continuous research: *“because we are in the sciences, everything we say must have come from research, at some point it’s been researched, and therefore all our teaching is by definition research-led”*. However, the link between research and teaching is managed on a practical level through course design and delivery. Distilling information that is current and integrating it with course content was considered by all the staff interviewed to be an essential part of their teaching and something they felt they did well. A strong emphasis was also placed on the need to convey how research generates new knowledge and to support students in acquiring and developing skills associated with particular approaches and the analysis and interpretation of data.

Although it is possible for specialist courses to be aligned with staff research, some members of staff consider their own research to be far removed from their teaching, either as result of the level, the technology required, confidential material or constraints of the curriculum. However, in these situations the link was still made possible by staff bringing their knowledge and expertise as a researcher to the material they teach; gleaning current knowledge and introducing it to students at different levels in appropriate ways. Several staff commented that those who are research active or working in a research-active environment, even if they themselves are not currently research active, make connections between their role as a researcher and their role as a teacher. This was felt to be most evident when staff are teaching outside their particular research area. For example, as one member of staff explained:

Most people because of the culture we operate in do [link research and teaching] instinctively. There's often quite a lot of what you teach potentially at a lower level where the research has relatively little to offer as it were because you are dealing with material that is well established or textbook but even there you would try to enliven it by stuff you've got indirectly from your research and research interests. If you're active in research you are always going to be reading current material. It would be unnatural not to.

Staff described a range of approaches to develop effective links between research and teaching, which were irrespective of their subject area. Raising students' awareness of the current research and latest techniques in the discipline was certainly considered to be routine and was typically achieved by using material from recent conferences, publications, projects and subject networks as a starting point for student discussions and activities. These activities were often able to connect course content to departmental research areas. For example, one member of staff uses material from departmental research groups to set a familiar context for students in discussions or to explain particular research approaches. Another example provided was demonstrating search engines by searching for a member of staff in the department, raising awareness of the research activity in the department and the expertise available to students in-house. Staff felt that since students often have knowledge and experience of the different research areas in the department, making the connections across the department helped students relate more to the material. Another member of staff would go one stage further and include specialist lectures by staff in other research areas in the department to illustrate key approaches.

Developing students' awareness and experience of research methods and processes is also considered by most staff to be routine and was felt to be supported by the breadth of expertise in the department. For example, one member of staff felt that it was important to introduce students to methodologies that are not found in the general textbooks, explaining: *"the way I try to promote my research is by integrating the things I do in my research career with my teaching per se ... to introduce students to things that I know how to do well, which may not come across if I wasn't here"*. The activities they go on to describe are all designed *"so that students are basically interacting with research"* and learning by doing so. Students are encouraged to read research papers from first-year undergraduate level onwards and extract relevant information; they undertake small research projects at the end of the first and second year as well as a more typical independent third-year project; they search, use and sometimes visit real data sources; and they undertake small directed-learning activities, which encourage them to find out about new topics in the wider fields.

Many staff had extensive experience of forging research collaborations with students in the second and third year and at postgraduate level through a range of research projects. Several members of staff co-ordinated their research project students according to themes, with students working on different aspects of that theme. In this way students then have an opportunity to work as part of a larger research team, while at the same time raising awareness that research is rarely carried out in isolation. The same member of staff holds weekly research group meetings shared by third-year undergraduates and postgraduates interested in a particular field, where these students can discuss a range of topics out of interest, not necessarily related to an assessment. In some subject areas it is possible for students to contribute to staff research, working alongside them in their research area, collecting data with staff that is often included in staff publications and for which the student receives due acknowledgement.

The staff interviewed outlined an orchestrated progression in the development and application of research knowledge, understanding and skills in first-, second- and third-year undergraduate courses and through to postgraduate level. The experience is interpreted by some as holistic in its approach, moving from preparing the ground work to small-scale involvement through to larger-scale involvement and relative independence. Some members of staff commented that the approach is instrumental in helping to build student confidence gradually over time and experience.

In the first and second years research activities are introduced in a controlled way, but are seen as providing the foundations for future activities and cultivating a sense of 'research awareness'. A specific skills programme is integrated across all degree schemes, which focuses on key concepts of science and scientific methods, giving students opportunities to engage with the various processes of research design including ethics and risk assessments. For example, in the first and second years students are able to access real research data, which they can analyse and interpret. Students participate in series of research practicals over a specified number of hours to give hands-on experience of a range of material and techniques. At the end of these practicals students produce a reflective statement on their experience of being a research subject and answer specific questions about aspects of the research design. Students also give a PowerPoint presentation of a research paper of their choice to fellow students. These activities encourage students to be aware of the different aspects of the research process, which then provides a good platform from which to undertake a third-year independent project.

Students undertake a series of small research projects from the end of the first year, building their knowledge, skills and confidence progressively. The projects are closely aligned with staff research expertise and often linked to their current research interest, particularly in the third year and at postgraduate level. Topics and titles are agreed in collaboration between staff and students and provide an opportunity for students to apply the skills and knowledge acquired and practised to a lesser degree in earlier courses in a large independent project. In many cases the student projects contribute to research at the postgraduate level and in some cases to staff research or publications.

This progressive approach to building links between research and teaching is adopted by staff during the stages of programme design even when there is no explicit request to do so. It was also felt by many to be made clear to students from the outset. Although no member of staff interviewed articulated an explicit link between the department's strategies for research and learning and teaching, they were all aware of the common approach to programme design across the department. This included integrating current research and knowledge and including practical elements of research to differing degrees depending on the level of study and subject content. The precise relationship of research and teaching in any one course is largely determined by the individual member of staff according to the particular course and student group. There was, however, a shared understanding and range of approaches among certain subject groupings.

Staff in Department 2 are particularly active as regards innovations in learning and teaching, with several internal and externally funded projects underway at the time of the interviews. The learning and teaching projects are typically focused on aspects of student motivation and engagement and the design of material that will help to develop transferable skills and instil students with confidence. Whether there is a direct link between active engagement in learning and teaching innovation by staff

and their commitment to linking research and teaching was not explored in any detail and would be the subject of further work.

From the questionnaires and the interviews it is clear that the staff are very passionate about research. For some staff this was evident as a wide departmental research culture and more specifically as research communities across discipline groupings. A number of mechanisms for celebrating staff research successes in the department were identified time and again during the interviews including: the circulation of weekly bulletins providing general research news; achievements of staff and students being prominently displayed within the department; and a formal seminar programme providing opportunities for internal and external presentations, showcasing latest research and stimulating new collaborations. Staff felt that students were invited into the academic community in a range of ways in addition to the examples previously discussed. For example, a forum for third-year undergraduates and postgraduates provided opportunities for students to talk about their projects, and there are opportunities for students to present their projects to the department at a series of one-day events. A number of staff organise peer support groups for students undertaking research projects, and students are encouraged to actively contribute to staff research projects in some subject areas and to act as research assistants.

The experience of student engagement in the research communities varied among the staff interviewed. For example, some members of staff had a very positive experience of student participation in seminar events, others felt attendance was inconsistent. Some felt that it was difficult to encourage student participation in seminar events either as a result of the content or the level of difficulty. For others, although recognising the difficulties, these events were still seen as potential opportunities to raise awareness of research methods and techniques and to cultivate a sense of community. This is evident from the comment below, although the number of students attending was unusually high:

... when I did my research seminar there were probably 30 or 40 of them. And some second years as well. When I presented on my research, I had one of my research students with me who was using the methodology etc. But it also led to one of the PhD students, who was working for somebody else, realising that he could do that as well. And a couple of other ones I went to were again, particularly well attended by a hard core of 15 third years and they tend to go again and again.

The staff interviewed had experienced a mixed response from students when they linked research and teaching activities, with some students very engaged while others less motivated by this approach. This could be attributed to the level of difficulty, the particular activity or teaching approaches adopted. There was an agreement among several members of staff that students can struggle to understand scientific concepts and research training, particularly in the first year of study. However, every member of staff felt there were clear benefits to students arising from strong links between research and teaching from the outset. These included: “keeping discussion current with students and students feeling they are getting the latest knowledge” and “making teaching unique and evidence-based rather than information giving without context”.

It was felt by some staff that students welcomed input from current research as long as it was relevant. Staff felt that students often demonstrate a very good understanding of their research interests, particularly at second- and third-year level and in the experience of some members of staff, were confident in approaching staff

for more information on their research areas. One member of staff had witnessed levels of confidence among second- and third-year students similar to that of postgraduates, with students willing to approach him to talk about possible project ideas. Another member of staff had witnessed a change in students as they developed a better understanding of research areas: *“you can see that people want to get involved with particular experts in certain fields and you can see that’s when they are starting to become more specialised.”*

It was recognised that striking the right balance between the core course content and introducing research knowledge was difficult. Some staff felt that there was a potential danger that intense involvement in research of a topic *“might easily skew their presentation of the subject because they focus not exclusively but disproportionately on the subject they are interested in”*. It was also felt by some staff that students did not necessarily appreciate the skills they were developing at the time they were introduced, but rather came to appreciate them later when they had opportunities to use them: *“they often see the value of it when they start doing their projects. I now get why you made us go off and do that. Or I wish I had gone off and read those reviews on this.”*

5.2.2. Student perspectives

In total, 16 students from Department 2 participated in the study, 11 of whom were undergraduate and five postgraduate.

The students’ understanding of what is meant by ‘research’ in their discipline included research as both original content discovery and research as a process of discovery. However, in general, the students in Department 2 placed the stronger emphasis on research as a process of discovery. Comments included: *“I consider the term ‘research’ to mean work or further study to further your knowledge and learning”*; *“proving (or discounting) a hypothesis”*; *“what I understand by research is independently exploring new ideas or concepts and building them with practical data”*; *“extending your knowledge and depth of learning on a particular topic or area of study”*; and *“a logical way to prove myths about life”*. There was also a clear sense from several students that research did not necessarily have an end point, but was instead characterised as being a journey: *“frustrating – lots of things may fail along the journey and so a lot of perseverance is necessary”*; *“getting answers to unsolved questions and picking up new problems that require solutions along the way”*. There was no immediate distinction between the comments from undergraduate and postgraduate students; however, there was some difference in experience between the different subject areas.

In discussions it seemed that students were very much aware of the research activity being carried out within their institution and more specifically within their department, which was widely recognised as having *“a good reputation for research”*. Interestingly, however, this was not necessarily reflected in their initial questionnaire responses. Some students were able to identify a national reputation of the department with most having a good knowledge of the specific research interests of staff. These interests were circulated widely within the department through a range of mechanisms including departmental emails, noticeboards, recent publications and articles, research seminars and more generally through engagement with staff themselves. Students also became aware of the staff’s research through more formal teaching scenarios: *“get told by the lecturer at the end of his/her lectures”* and also *“because books have been published by them and many of them have discussed research they are carrying out”*.

Students seemed to have a good understanding of how research can be linked to teaching, identifying a range of approaches: *“when you are being taught by a specialist in their field of research with a slant on their findings”*; *“participating in the lecturers study and learning from taking part”*; *“teaching that is based on a collection of people’s work”*; *“teaching led by a researcher”*. Students had experienced research in the curriculum at a number of different levels from the first year onwards and gave many examples: *“1st year coursework was related to lecturer’s own work – was shown copy of his work”*; *“... currently involved in a project for my dissertation in which my lecturer is hoping to have his work published and we were there helping test”*; *“it’s been drummed into us since first year”*; *“we had two days set aside for practicals in first year, had a whole module through our second-year practical modules, which developed our research skills and a final-year research project for three months with an option to take a year out in a lab in the third year – that’s a lot of research exposure!”* Students also had been given opportunities to participate in projects and work within research teams for their final-year projects: *“we do our final-year project in research teams that are already working towards specific interest”*. For some students, opportunities to actively participate in staff research had been available to them from the second year onwards: *“working alongside researchers and others in the labs over the summer on a studentship”*.

Embedding research into the curriculum was recognised as being extremely beneficial by the students: *“it can help us in career prospects. It can also make education more fun”*. Other comments included how the inclusion of research skills in their studies *“makes learning more relevant and more realistic”* and the fact that several skills are embedded within the process such as project management skills, communication skills, organisational skills, managing workloads and record keeping. For example, one student commented that *“it teaches one a lot of patience and organisation and teamwork”*, another that it had helped to develop self-confidence: *“I have better thinking and problem-solving skills – other transferable skills like public speaking, reading skills from exposure to various scientific papers and confidence built from being able to write a 10,000 word essay.”*

Some students felt that research adds value to a degree: *“A degree is worth more if you have done a research project than not at all.”* In particular, final-year projects and other independent projects that students have to undertake were viewed as a way to apply acquired knowledge and skills and *“it shows that you have been willing to work independently and shows that you are able to carry out things on your own”*. For a small number of undergraduate students experiencing research first hand through involvement in research teams and projects or their final-year project had made them consider either a career in research or continuing their studies. This interest was fuelled both by the research angle itself and by the range of more transferable skills the student felt they would gain as a result.

The students interviewed perceived that there is a strong academic/research community within the department. In fact, they were able to identify a number of smaller research communities within the larger community, which were centred around a particular supervisor/researcher, a research lab or a research team. The students felt included in the wider academic community, but tended to feel more included when they started working within project teams or on research projects. The students felt that access to the communities helped them to develop their confidence to engage with material, and they very much valued this increased support from staff and peers. Specific examples included receiving tips on how to perform scientific techniques and learning about the most common mistakes. Feeling part of the community also seemed to have increased their self-esteem and

sense of contribution to the department: *“We feel like we belong to something that might contribute to change the concepts of science.”*

Even though the students interviewed generally felt part of the academic community they were still keen to suggest ways to strengthen the research-teaching link. These suggestions were wide ranging and moved between encouraging even more contact between staff and students and providing more physical resources within the department. Several students suggested a regularly updated overview document of research activities and progress: *“early exposure does a lot of good in making people find their interests”*; *“would help me pick the research team I can join in the final year”*.

Some students did raise some concerns that although lecturers that are conducting their own research and teach the same subject *“have more enthusiasm about their subject”*, they can be *“sometimes a bit too excited and keep going on about it and not finish the lecture”*. This focused mainly on referring to research in lectures and classes rather than the research-based activities the students were often engaged in. Most negative comments focused on the ability of staff to translate research activity into accessible language at the undergraduate level. Echoing some of the comments by academic staff, not all students were positive about engaging in research activity from an early stage with some describing it as *“daunting”*.

5.3. Department 3

Department 3 is a medium-sized department with an established reputation for research and teaching as evidenced by QAA and RAE processes. It has an international reputation with leading experts in all its major research areas. It has research and teaching laboratories equipped to the highest standards. The department negotiates the requirements of a professional body.

5.3.1. Staff perspectives

It was evident from both the questionnaire and the interviews that staff believed they were able to make links between their roles as researcher and teacher. One member of staff interviewed felt that it was actually impossible to keep the two roles separate, explaining that in their experience:

... the material that I learn, the papers I read and the papers I write even more so influence what I teach as much as the University will allow because there are difficulties including new material but as much as it is possible I have the latest research results as part of the course ... teaching means enthusing and you need to excite students and even if you are doing run of the mill stuff you still need a research component.

Staff largely shared a broad definition of the relationship between research and teaching, which included teaching informed by the latest research in the subject as well as the acquisition and application of research skills by undergraduates and postgraduates. Some members of staff considered their own research to be far removed from their teaching either as result of the level, the technology required, perishable results or restraints of the curriculum. A minority felt that research was distinct from teaching, placing the stronger emphasis on research as original discovery rather than process. However, all staff brought their knowledge and expertise as a researcher to the material they taught, distilling current knowledge and

introducing it to students at different levels. This was evident in research active and non-research active members of staff:

It is important that non-research active members of staff should include the current research in their teaching. They can do that either by interacting with their colleagues who are involved in research of you like, distilling the essence of that knowledge and passing it on to students or interacting with colleagues at other places or literature or up to date textbooks and in fact that's how I view my role as a teaching fellow, to distil what I feel is current.

Similarly to Department 2, although staff recognised the potential to link research and teaching, many felt that there was a need for it to “*be done within the context of or with a firm view of the curriculum; otherwise there is a risk that things become disjointed*”. This was not felt to be a simple process and was affected by a number of variables.

Staff employed similar strategies to develop effective links between research and teaching. While it was not always possible for staff to use their own research data in the courses they taught, particularly at the first-year undergraduate level, staff routinely included material from recent conferences and publications in their teaching. Staff also applied their own research skills in their teaching to assist irrespective of the subject matter being taught. Examples provided included: taking examples of staff's own research material and using them with students as a case study to illustrate a particular aspect of the course; and designing assessed tasks that require students to conduct experiments in order to solve a problem and report on the approach they selected. These types of activities were considered beneficial as students can benefit from the expertise of the staff and gain first-hand knowledge of how research processes were applied to create new material. Other examples cited included extracting information from journal papers or relevant websites, scientific report writing, conducting literature reviews and small research projects, and other discipline specific professional skills.

The links between research and teaching are designed by individual members of staff and are not felt to be prescribed by the department. The links are also most explicit at undergraduate level in the third-year project and within a number of professional skills activities. Research methods are not currently taught in specific undergraduate modules, but rather integrated as appropriate. Research methods are, however, taught explicitly as part of postgraduate programmes. Undergraduate optional courses at the second and third year as well as postgraduate specialist courses provide opportunities to link research with teaching as these tend to be closely aligned with staff research interests. Such specialist courses enable students to benefit directly from the wealth of international expertise in the department, often in niche areas. Coursework set as part of these courses tends to involve an element of research and students may have to study research papers and explore current research findings as well as apply particular techniques.

Undergraduate projects are aligned with staff research interests, and the titles are decided in discussion with students. The majority of students choose a pre-defined topic, but as many as 20% of students choose their own, and identify a suitable supervisor. At the postgraduate level, the projects undertaken are more aligned with the staff research interests. These create the opportunity for students to experience and explore current techniques and methodologies and even contribute to staff research. Some staff felt that while it was preferable to align research interests with specialist courses, it was not always possible, particularly at undergraduate level:

some areas of staff research are highly specialised and do not easily meet the broader requirements of the degree programmes.

The skills students acquire and develop during their studies are generally promoted through the departmental literature and by staff during courses. However, the specific profile of research skills was thought by some to be not as high as other transferable skills.

Standard quality assurance mechanisms are used to evaluate and reflect on existing provision. The integration of research is not necessarily an explicit component of these processes, but the processes were felt to be rigorous and comprehensive. None of the members of staff interviewed articulated an explicit link between the department's strategies for research and learning and teaching; however, in the examples provided and the discussions that ensued, they all identified shared departmental approaches.

From the interviews it was clear that the staff are very passionate about research, and a number of specialist research groups exist within the department organised around research themes. A research seminar programme of internal and external speakers is run by the department with students invited to attend if it is relevant to their studies. In addition to the departmental seminar series, some members of staff design specialist research days, which include presentations from staff and postgraduate students to which all students are invited. A special research colloquium is organised every year where second- and third-year PhD students present their work, to which undergraduate and postgraduate students are invited. This event is an opportunity for students to find out about the areas of research in the department and get inspiration for final-year and MSc projects.

A number of mechanisms for celebrating and disseminating information about research successes were identified. For example, a departmental newsletter promotes staff publications and conference presentations as well as other research-related successes in the department. An internal technical report series enables staff to make research results available before they are formally published. Staff and postgraduate research students display posters from conferences and research projects on departmental walls. Staff research and teaching profiles are created online, providing a synopsis of research interests, teaching responsibilities, collaborations and projects as well as new ideas for student projects. Staff are encouraged to maintain their own personal web pages and include information about their research interests and ideas for projects as well as make their publications available online.

Students were felt to have a good awareness of the research in the department and the expertise of staff, which was demonstrated during formal and informal exchanges. However, student involvement in the research community in the department was felt to be at its strongest in the third year and at postgraduate level, when student participation was more immediately evident. This was attributed in differing degrees to the level of material and the competing demands on students' time.

The staff interviewed experience a mixed response from students to research-linked activities in courses. A number of students are very engaged, while others are less so. Again, this is attributed to the level of difficulty of the material, but was also influenced by the particular activity or teaching approaches adopted for particular cohorts. For some it was felt that *"if it is done well, they respond well"*. A number of staff felt that it was important to strike the right balance between the research

interests of academic staff and the prescribed content of an undergraduate degree programme. It was important for the links to be managed effectively or there was a danger that *“researchers will go off down avenues that are of fascinating interest to them but aren’t necessarily relevant to a rounded degree”*.

5.3.2. Student perspectives

In total 11 students participated in the study: eight undergraduate and three postgraduate.

The students appeared to have a general understanding of what is meant by research and how the term is used. For some students it was seen as an umbrella activity that included *“learning, discovering and creating for a certain subject”* or *“to provide students with the ability to get involved in something they are interested in”*, but for the majority it was very much associated with innovation and original discovery: *“research is an original investigation taken by a researcher in order to gain some understanding and increase knowledge”*; *“the process of developing new ideas in a field and furthering new ones.”*

The students were well aware of the research that is being undertaken within their university through the various seminars and conferences taking place as well as through advertisements for research opportunities, exhibitions and displays and finally the various research outputs produced by members of staff (books, articles etc). Students were also aware of the research that their lecturers were undertaking within their department, particularly through their publication profiles and their supervision of research students in particular areas. Students were made aware of the research being conducted by staff in a number of ways: websites, posters, advertisements, regular seminars and the material used in lectures and classes. Publications by members of staff are available online, and they may be used in lectures as materials for reading. Students commented that some of the lecturers explicitly talk about their own research work in classes and include materials such as papers. Some students would like to know more about the staff’s research interests; for instance, in the context of final-year projects. However, others were not keen to receive more information; they already felt overwhelmed by this material.

Students had a good understanding of how research is incorporated into the curriculum. Most interestingly, students initially felt that they had mostly experienced research in the curriculum in the form of research-informed teaching: *“when the course material draws heavily on current and recent research”*; *“when the lecturer teaches something he/she was undertaken research in”*; *“when the course material is not from a book.”* Although students went on to describe how they had experienced the link in other forms too: *“involving students in research to increase students’ understanding of research and helping the researcher to conduct his/her research”*; *“encouraging students to interact with ongoing research and lecturers using their own research to provide extra knowledge”*; *“the idea of using research as part of a course”*; *“share the ideas from research by the way of teaching”*.

Students had also gained experience via a number of research-related activities such as reading research reports, attending seminars and hearing members of staff talk about their research in lectures. Perhaps owing to the nature of the particular discipline, only a very small number of students had gained experience by being subjects or participants in experiments or getting involved in practical fieldwork. One of the prevalent practices is the undertaking of a final-year project by all students. The students perceived that they gain research experience through this process,

which also includes the writing of a substantial dissertation: *"I think my dissertation has been helpful in gaining experience with the research process."* They also seem to gain a degree of self-confidence by conducting a project on their own as well as increase their *"research skills both academic and industrial"*. More transferable skills were identified as part of this final-year project and included project management, time management, independent learning, self confidence and expanding horizons.

The students interviewed felt that involvement in research activities is more likely to happen towards the end of undergraduate studies (i.e. individual project/dissertation) or at the postgraduate level, and this is what emerged from the focus groups and questionnaires. There was a difference in experience depending on the level of study, and consequently comments in this section have been separated out by level of study.

Undergraduates

From the discussion within the focus groups it emerged that the students perceive that there is indeed an academic community within the department, but rather than it being one big community encompassing all staff, there are a number smaller communities that seem to be centred around research groups. The students did not feel that it is essential for them to feel part of the community, although it would be desirable to engage with the community more frequently. Students perceived that being a member of the wider research community could bring a number of benefits including: helping them in their learning; widening the subject; providing networking opportunities; enhancing final project supervision as they would be able to get more feedback from other academics and other members of the community; and an indirect effect on the quality of their coursework as it would improve their motivation.

Postgraduates

The postgraduate students felt there is a research community within the department of which they are also members. Through the community, students learn about the staff's research interests and are able to read related research papers. There are also a large number of PhD students in the department with whom the students interact; for instance, during laboratory sessions and classes. The students commented on the fact that the department operates an open-door policy, and there is very good interaction among MSc students. However, it was felt that there could be more interaction with the undergraduate students.

The students felt that the existence of a common room where they could meet with other students and members of staff in a relaxing atmosphere would help strengthen the relations between students and staff and strengthen their sense of belonging in a community, which in turn would help them to develop new ideas for projects. It is worth noting that such a space is currently available within the department, and therefore a more structured or managed use of the space might be necessary initially to support the continued development of a departmental community.

5.4. Department 4

Department 4 is a relatively newly established department, which has already established a national and international reputation for research and teaching excellence. It is a large department with a high staff-student ratio, but nevertheless consistently achieves excellence in all formal reviews and surveys. The department negotiates the requirements of a professional body.

5.4.1. Staff perspectives

Every member of staff interviewed believed that they are able to make effective links between their roles as researcher and teacher, with some staff strong advocates for linking the two roles. There was a shared assumption that the discipline was founded on, and is sustained through, continuous research and that as a result the link between research and teaching is pervasive. However, establishing and sustaining links is not seen as a simple process that can be easily broken down as a formula. The precise form the relationship takes will inevitably vary according to the different teaching scenarios staff are involved in at any one time; one member of staff suggesting that the best fit comes about through negotiation with colleagues and with students themselves.

Distilling information that is current and integrating it with course content is considered to be an essential part of teaching and something staff feel they do well. A very strong emphasis is also placed on the need to develop students' understanding of research and its impact on the discipline. Conveying to students how research generates new knowledge, through the formation and testing of theories and analysis of data is considered an essential component of the courses, and all staff have experience of this approach.

Although second- and third-year courses are aligned with areas of staff research, some consider their own research to be far removed from their teaching, either as result of the level, the technology required, confidential material or constraints of the curriculum. However, in these situations the link is still possible as staff bring their knowledge and expertise as a researcher to the material they teach, gleaning current knowledge and introducing it to students at different levels in appropriate ways.

Staff employ very similar strategies to develop links between research and teaching across lectures, seminars, practicals and projects. Raising students' awareness of the current research and latest techniques in the discipline is considered to be standard and achieved by using material from recent conferences, publications, projects and subject networks as a starting point for student discussions, tasks and workshops. Staff felt that using examples from recent research in this way helps to locate theory, which can be difficult or challenging, within a better context for students and at the same time widens their knowledge of research across the discipline. While it was not always possible for staff to use their own research data in the courses they taught, particularly at the first-year undergraduate level, they regularly applied their own research skills in their teaching to assist with practical content and workshop materials irrespective of the subject matter being taught.

Approaches included introducing research as a process to students teaching them how to test a theory, collect and analyse data, write reports and also how to treat research participants. From the first year of a programme students gain practical experience of every aspect of research not only through specifically designed tasks and activities, but also through participation in research projects as subjects for a fixed number of hours during their studies. For one member of staff the first year was an opportunity to help students to see *“that simple experiments can solve complex empirical problems and try to bridge the gap between data collection and theory”*.

There was a distinct emphasis by staff on the importance of staff and student research collaborations as one of the most effective ways to link research and teaching. This is very evident in the second- and third-year student projects where topics can be closely aligned with staff areas of research in order to ensure appropriate support and guidance. Some members of staff organise students into

research groups, which establishes a form of peer support but also helps to raise awareness that research is made up of many different strands of information and rarely takes place in isolation. Particularly at the end of the third year there are opportunities for students to act as research assistants in the department, usually working with their project supervisor to continue their research for a period of two to three months, and regularly leading to publications. Voluntary studentships, which are well received by students, are also available outside term time. These provide students with opportunities to work with a member of staff on a specific project and to refine their research skills prior to the third-year independent project.

The department is associated with innovation in learning and teaching, particularly with regard to understanding the research process. For example, one member of staff has recently received internal funding to develop a series of training materials for students that will equip them with technical skills and knowledge of equipment commonly used in a particular type of research.

There was an expectation by all staff interviewed that students will develop research skills and engage in research projects during their time in the department. This was felt to be addressed during the stages of programme design and made clear to students through the programme outcomes and the departmental literature. Although the expectation that students engage in research activities is a requirement of the relevant professional body, it was also felt to be embraced by the department.

The staff interviewed all outlined the progression in the development and application of research knowledge, understanding and skills in first-, second- and third-year undergraduate courses. One member of staff felt that this approach was particularly effective as it breaks down the research process, preventing students from being overwhelmed by research and instilling them with the confidence they need to engage with the discipline, whatever level they are at. The skills students acquire during their studies are explicitly listed in the department literature.

A large research component runs throughout the three undergraduate years, and research skills were described by staff as being “*littered*” throughout the programmes. Two courses on research methods ensure that half of the first year is spent on developing student understanding of research. In the second year, courses on research methods build on the knowledge gained in the first year and are complemented by four research-led assignments often linked to staff research. In the third year, students choose six optional courses taught by staff who research in these fields of interest or in a related interest. Students also conduct individual research projects of their choice aligned with staff research interests. Staff agreed that it was rare for students to design their own project without any input from staff, and those that do are typically advised that staff are not as knowledgeable in this area as other pre-defined topics. One member of staff felt that there were key ethical considerations to be taken into account when designing a project, as well as cost implications for some research areas, and that as a result projects should be developed in collaboration. Many of the student research projects contribute to staff publications with approximately 30 to 40% of staff publications including undergraduate or postgraduate contributions. On the whole the contribution was felt to be in relation to data collection and not necessarily a contribution to the text or theory, particularly at undergraduate level, although this was not always the case and some students could be working on novel research in the department.

Standard quality assurance mechanisms are used to evaluate and reflect on existing provision. The integration of research is not necessarily an explicit component of

these processes, but together with the requirements of the professional body these were felt to be comprehensive and rigorous.

Similarly to other departments it was apparent that the staff are very passionate about research, and a research culture is very much evident through the activities of local research groups, which are organised according to subject specialism. The transition from a research culture to a research community was seen to be a challenging area, largely due to the level of some research activity. A number of strategies are employed to raise the profile of research activity and celebrate the achievements of students and staff. For example, staff publications are promoted throughout the department whether on a departmental database and staff web pages or visible through a seminar programme. Student awareness of staff research was also felt to be raised by student participation in research projects.

All staff and students are routinely invited to weekly staff seminars, with undergraduates especially encouraged to attend if the session is particularly relevant to a current module. Postgraduate students can have a follow-up seminar from visiting speakers that targets their level of understanding specifically. Some members of staff felt that it is difficult for undergraduates to genuinely participate in the research seminars and that this was reflected in their attendance figures, but felt that there was considerable value in providing opportunities for formal and informal exchanges with research-active staff.

The staff outlined a number of alternative strategies for providing formal and informal exchanges between staff and students in the department. For example, staff and postgraduate research students display posters from conferences on departmental walls. During the second year, students are given a presentation regarding third-year options and projects to encourage them to think about their subject choices. This event is combined with poster presentations by third-year undergraduates on their research project to the whole department. This is an opportunity for second-year students to view posters and gain advice on project choice and supervisors. Similarly the third-year students attend a meeting on postgraduate study where they can discuss postgraduate opportunities with staff. These events were seen by one member of staff as *“a great opportunity to share research knowledge and students love it”*.

A strategy for sharing physical space has also been implemented whereby students can book research and computer labs, meeting rooms and teaching rooms. This is a very flexible system to offer students communal learning space around the department and facilitate group studies. In addition, any equipment bought for staff research projects can be used for third-year projects.

From the questionnaires and the interviews it seemed that students mostly responded well to the research elements of their studies, displaying a degree of enthusiasm and welcoming the opportunities for creativity. This was particularly evident in second- and third-year students. However, as one member of staff explained, it can be hard to engage students in the first-year undergraduate courses when the emphasis is on introductory research methods, bridging the gap between data collection and theory: *“First years are keen on carrying out procedures, the practical side of things, but are less keen on analysis and statistics and drawing conclusions. They can understand the procedures but find it difficult relating the procedures to ideas. They can find this difficult and tedious, this may be because we haven’t got the examples right or the students lack the ability to make the link at this stage. But they have to be taught the fundamentals; students need to understand the concept of research to be able to do it.”*

This was echoed by another member of staff whose experience was that *“most students like the practical side of the course, designing and running experiments and collecting data but there may be an element of frustration if I teach them ten theories that are wrong, they can get demoralised. All theories basically get disproved and students need to know the history of how theories are proposed and disproved; the evolution of theories.”*

5.4.2. Student perspectives

In total 20 students participated in the study, 16 undergraduate and four postgraduate.

Students demonstrated a varied level of understanding of the term ‘research’: *“testing ideas to be true or false”; “performing experiments and reading about previous work to learn more about a subject”; “searching using various methods to find out about a topic or interest”*.

Students are very aware of research being conducted within their institution and department. At the institutional level, the students are aware of conferences and seminars being organised and potential opportunities for research and postgraduate study. Students are familiar with research units within the institution and the research output produced. At the departmental level, the students are very aware that staff are research active and of the research reputation of the department: *“the department is heavily involved in research and has some leading researchers”*. The reputation of the department had influenced some of the undergraduate students when they were choosing where to study: *“yes, that is one of the reasons I transferred here!”; “the reputation of the research conducted is one of the reasons I chose this university”*. Posters, announcements on noticeboards and via email, and up-to-date web pages all contributed to making the students aware of the research activities of staff.

Students had a good understanding of how research can be linked to teaching: *“teaching by way of planning and performing experiments to help the student learn through doing”; “where staff teach you about their previous research through discussing it in lectures and through your reading their journals and textbooks”; “lead your study and reading and guide your learning from their own knowledge”; “like a supervised project where a teacher leads you through the steps although you yourself are completing the research. The teaching offers guidance.”*

However, students recognised that in order to be able to engage in research, they first needed to build the knowledge that would help them to understand the more advanced concepts: *“background to subject needs to be established to create foundations before looking at detailed research”*. The department integrates research methods throughout courses and although feedback on this was positive, it was through first-hand experience of research that students felt they were able to appreciate better the benefits and difficulties of conducting research: *“well in the first year we had a module on research methods – I think actually conducting research yourself through coursework etc helps the understanding more however”*.

All students undertake a final-year project in which they have to carry out research under the supervision of a member of staff. The experience of some students with their project is described very positively: *“my 3rd-year project was a real eye opener to how research is carried out, and how to conduct my own research”*. Some students see the project as an opportunity *“to apply what I have learned over the past*

two years to a topic area which I am most interested in". Carrying out an independent project was also perceived to be a key transferable skill: *"I think employers are impressed when you can show that you have planned and carried out a project on your own (or in a group)."* Being exposed to research at different levels of the curriculum and also having had the opportunity to conduct an independent project had had a positive effect on the students. The majority of them were considering continuing at postgraduate level.

Students felt that there was an academic community, although this was seen as a number of smaller communities often centred on lecturers and students working together in projects. These communities were felt to become more 'knitted together' when students undertook the independent research projects and were supported by individual members of staff. Although the students did not feel that it is necessarily important to feel part of the community, they saw the potential benefits as widening their knowledge and improving their learning as well as improving their motivation.

Again the results from the questionnaires and focus groups echo previous findings in the literature. The credibility of teachers and the quality of their teaching is seen as being enhanced when they conduct research. Their enthusiasm in their subject can be *"contagious"*. Being taught about recent research findings also *"keeps the subject fresh"*. The students see a number of other potential benefits including acquiring transferable skills: *"...critical awareness and thinking, analytical skills, ability to apply oneself etc."*; *"we learn a lot of transferable skills we can take with us"*.

Students did not perceive research to have a significantly negative impact on staff engagement with students, although some students recognised that there were competing demands on staff time and their availability was sometimes restricted.

5.5. Department 5

Department 5 is a large, well-established department with a leading reputation for research and teaching as evidenced by QAA and RAE processes. It has a successful track record of attracting external funding to support its national and international research activities and is currently undertaking many industrially sponsored and research council funded projects.

5.5.1. Staff perspectives

It was evident from both the questionnaire and the interviews that every member of staff believed that they were able to make links between their roles as researcher and teacher. The staff generally expressed the view that the discipline was founded on, and is sustained through, continuous research. As a result there was an assumption that the link between research and teaching was automatic, although the precise form the relationship took would inevitably depend upon the teaching scenario.

Staff largely shared a clear and inclusive definition of the relationship between research and teaching, which included teaching informed by the latest research in the subject and the acquisition and application of research skills by undergraduates and postgraduates. The need to convey how research generates new knowledge was considered important by several members of staff as well as the development of the skills associated with particular approaches, analysis and interpretation of data. As one member of staff explained:

There are two levels, general and specific. On a general level it is about getting students to understand that unlike when they are at school and college what they are finding out is not black and white, there are shades of grey which depend on how you ask the question in a certain context, and the further they advance their education at university level the closer they will get to the boundary of when their own approach has to be investigative and analytical rather than believing what they are told. On the specific level it relates to own personal research interests, which hopefully will impact on the teaching that you do and the methods that you use.

For another member of staff the relationship between research and teaching was characterised as follows:

It is an engagement in scholarship, hands-on experience. It should influence directly or indirectly the curriculum or the way students are taught.

It was evident that staff in the department employed similar strategies to develop links between research and teaching. Staff routinely raised students' awareness of the current research and latest techniques in the discipline, with the specific approach and material determined by the needs and capabilities of different levels of study. While it was not always possible for staff to use their own research data in the courses they taught, particularly at the first-year undergraduate level, staff routinely included material from recent conferences and publications in their teaching.

Some members of staff felt that although the relationship between research and teaching could be more explicit, it was "*a natural process that permeates everything and not something that is bolted on, more of an integral part of the course*". The link was not necessarily a conscious link, but an implicit expectation. For example, technical tasks will often require students to research the topic, produce results, write a report and present the findings. It was felt that "*this gives students experience of the whole research process*".

None of the members of staff interviewed were aware of an explicit link between the department's strategies for learning and teaching and research. However, it was considered to be implicit in staff discussions and at different stages of programme design. Several members of staff felt that the potential to connect research activity of staff and teaching provision was explored informally across the department. Some staff felt that although it was preferable to align research interests with specialist courses, it was not always possible particularly at undergraduate level: some areas of staff research are highly specialised and do not easily meet the broader requirements of the degree programmes.

Research methods are not taught in separate modules at undergraduate level, but rather integrated throughout the undergraduate programmes with opportunities for students to acquire and develop skills of literature searching, report writing and practical skills, and carry out mini-projects. Research methods are more explicit in the third-year project. The projects are aligned with staff research interests and latest research findings. Titles are agreed in collaboration with students. Some members of staff actively encourage students to define their own titles; however, few decide to do so.

Standard quality assurance mechanisms are used to evaluate and reflect on existing provision. The integration of research is not necessarily an explicit component of these processes.

From the questionnaires and the interviews it was clear that the staff are very passionate about research, and there was a strong research culture within the department. A number of specialist research groups exist, organised according to subject theme, and a departmental research strategy group and research away days provide opportunities to share research achievements. Second-year PhD students are also asked to deliver conference style presentations to the department.

A number of mechanisms for celebrating research successes were identified. For example, a departmental newsletter lists staff publications, grants and news bulletins, and seminar presentations are also held in the department. Staff research interests are published in departmental literature and web pages. A small number of summer studentships are sometimes available to help develop new research-led experiments for undergraduates or lab-based practicals. It is unusual for students to contribute to staff research as projects are usually externally funded with strict timescales and technical constraints.

Student involvement in, and awareness of, the research community in the department was felt to be strongest in the third year and at postgraduate level, when student participation was more likely.

The student response to research-linked teaching varied in the experience of staff interviewed. This was attributed in differing degrees to the level of difficulty, the particular activity or teaching approaches adopted. Staff felt that the challenge is not only to link the two activities, but also to link them in the right way, striking a careful balance between the core content and the broader understanding of research. This was particularly evident during the early undergraduate years, which are key stages for building student confidence and skills.

5.5.2. Student perspectives

In total 11 students participated in the study: eight undergraduate and three postgraduate.

Similar to the responses from students in the other departments, understanding of the term 'research' varied. The majority seemed to focus on aspects of discovery and knowledge rather than the process of research: "*exploring new areas*"; "*undertaking a project which will improve our knowledge or the technology available to us*"; "*research is the word that defines the interest in a specific area*".

Some students were aware of the research being undertaken within the University through various seminars and conferences, exhibitions and posters, and some were also aware of the existence of specialist research units. Students were generally aware that staff are research-active, and some were able to identify specific areas of research highly regarded externally. Students also identified a number of ways through which the department makes its own research visible, ranging from emails about conferences and seminars, contact with supervisors and a weekly bulletin that lists new staff publications and current projects. In general students felt that they would like more information about staff research, and one of the suggestions that emerged from the focus groups was to organise a staff seminar every week where staff could talk about their research interests. Some students would welcome opportunities to work along with staff in research projects, although they recognised that this might be difficult.

Students had a good understanding of how research can be incorporated into the curriculum with the strongest emphasis placed on research-informed teaching: hearing about “*research during lectures ... makes the subject more real and definitely more interesting*”. Students were also aware of the challenges staff faced when trying to integrate research at the cutting edge of the discipline with first-year undergraduate courses; for example, when the basic knowledge base had not yet been established.

Although several students commented that links between research and teaching were more common at the third-year undergraduate level, several described experience of research-related activities such as reading research reports, attending seminars and hearing members of staff talk about their research in lectures. In particular some students felt they had gained research experience through undertaking an individual project, which had provided opportunities to gather “*more in-depth knowledge into a particular subject area*”. A number of transferable skills were identified by the students as part of a research project or similar activity. These included time management, managing deadlines, report writing, communication and leadership skills. On a different level, students commented how the inclusion of research in their studies “*gives us an idea of how your subjects and modules actually apply and fit into the real world*”. Another student felt that it encouraged a sense of pride in the department: “*It is encouraging for students to learn techniques that we are told were developed within the department and are now used worldwide.*”

The students recognised the existence and benefits of the academic community within the department, which was divided into smaller sub-communities for research areas. The students felt that the communities were more accessible by third-year and postgraduate students. The department has a rich programme of seminars, but there could be more encouragement to attend at the undergraduate level, and it was suggested that perhaps attendance to some of these seminars should be compulsory or that research seminars targeting undergraduate students could provide more information to students in an accessible format. Students identified a number of potential benefits from engaging and being part of the academic community: “*wider knowledge base*”; “*experience on more diverse topics can be gained through discussions with members of staff*”; “*the practical experience and the teaching process would be more integrated*”.

The students perceived a number of benefits in their teachers conducting their own research including “*credibility*” and a sense of increased “*departmental pride*”. The students also agreed that staff involved in research were more enthusiastic about their subject, and as a result their own motivation increased. One student commented that being exposed to research “*helps broaden the learning experience of the students at the University*”.

Several students were aware of the strain between the two roles of staff as teachers and researchers and that as a result their availability was sometimes restricted.

5.6. Department 6

Department 6 is a medium-sized department, which has grown rapidly in recent years. It offers a wide range of provision comprising part-time short schemes, degree pathways, Masters and doctoral level programmes for professionals as well as undergraduate and postgraduate degrees. The number of postgraduate students in the department outweighs the number of undergraduates.

5.6.1. Staff perspectives

It was evident from both the questionnaire and the interviews that every member of staff believed that they were able to make links between their roles as researcher and teacher. In the experience of one member of staff the link between research and teaching was automatic: *“you can’t teach without a passion for the subject and this passion must come from something other than teaching it. If you don’t engage in current research-based teaching, teaching will become stale.”* This view was not articulated by all members of staff, however.

On the whole staff shared a broad definition of the relationship between research and teaching, which included teaching informed by the latest research in the subject and the acquisition and application of research skills by undergraduates and postgraduates. The links were often felt to be implicit in effective researching and teaching: *“If lecturers are researching it should come through naturally in their teaching, it is an opportunity to embed their own work in lectures.”* The more explicit links were felt to be more prevalent at third-year undergraduate and postgraduate levels where research interests and courses could be more easily matched. Staff recognised that *“certain areas of research are very specialised and it would be difficult to integrate into the teaching programme as it’s not relevant to the students”*.

Staff in the department adopted similar strategies to develop links between research and teaching. Staff routinely raised students’ awareness of the current research and latest techniques in the discipline, whether this resulted from their own personal research or the discipline more widely. While it was not always possible for staff to use their own research data in the courses they taught, particularly at the first-year undergraduate level, staff routinely included material from recent conferences and publications in their teaching. Examples provided included: using real examples from research to illustrate problems and stimulate class discussions; identifying journal papers and structuring essays around it; discussing the nature of research, critically appraising the methods and identifying the limitations of a study; problem-based learning scenarios; critiquing journal papers related to current module of the time via a journal club that meets once a week; constructing a portfolio providing research evidence to support learning outcomes and personal development planning. Some members of staff had previously restricted these approaches to postgraduate students and were recently introducing them to the undergraduate curriculum.

Student participation in staff research was not common owing to the nature of the research activity and ethical constraints.

Research methods and skills are progressively introduced to undergraduate programmes from the first year onwards, equipping students with skills needed to complete the third-year project, which is a compulsory requirement. In addition, study skills training includes sessions on literature appraisal, use of resources and building an argument. Research methods are explicitly taught at postgraduate level. Research methods are made clear in learning outcomes and listed in departmental literature.

Several of the staff interviewed felt that there was an impetus to develop links between research and teaching in new programmes. Some staff felt that there was a focus on understanding and appraising research rather than actually carrying out primary data collection. This approach allowed practitioners to develop critical thinking and to review research and its applicability. These processes were felt to support lifelong learning and enable practitioners to interpret the results of research.

Several staff explained that there is an explicit requirement in the discipline to include evidence-based research to support the knowledge being taught; however, the precise format and structure is determined at the course level and by the teaching.

The majority of staff interviewed are not aware of an explicit link between the department's strategies for research and learning and teaching, although it was recognised by many that these strategies are constantly evolving and under development. One member of staff identified that the *"teaching and learning strategy outlines pedagogical research although does not refer explicitly to research-led teaching, the research strategy explicitly states that staff should facilitate teaching which is more congruent with people's research"*.

Standard quality assurance mechanisms are used to evaluate and reflect on existing provision and include a significant contribution from students. The integration of research is not necessarily an explicit component of standard feedback process; however, it was felt to be effective in identifying new approaches. For example, the introduction of a student-led seminar series in the department was in response to student feedback.

Once again it was clear that the staff are passionate about research and that there is a developing research culture within the department. A research group meets regularly, with an open invitation issued to the department, and there is a departmental seminar series, which showcases internal staff research as well as hosting external speakers. Students are invited to attend by individual lecturers, although attendance is not always high owing to other commitments. Departmental seminars, which are student led, have recently been introduced, and students are encouraged to suggest topics and speakers. One member of staff had designed a research student conference and poster session for postgraduates, which proved to be very successful with students appreciating the opportunity to network with each other and with staff.

A number of mechanisms for celebrating research successes were identified. The department makes good and effective use of online resources, circulating an online news bulletin to the department, and builds staff web profiles for students to find out about current research projects, publications, presentations and planned collaborations.

The staff interviewed had experienced a mixed response to research-linked teaching from students, with some students very engaged while others less so. This is attributed to the level of difficulty, the particular activity or the teaching approaches adopted. One member of staff described research as *"a hook to engage them"*, but there was a general agreement that it is difficult to integrate research and teaching during the early years of study, particularly research methods, which is often an unfamiliar subject. One member of staff felt that *"students don't necessarily make the link that teaching is better because more research is included"* and that in order to be effective the links needed to be relevant and well managed.

5.6.2. Student perspectives

In total ten students took part in the project: five undergraduates and five postgraduates.

Once again students' understanding of the term research varied between research as original discovery and research as a process: *"a process of systematic*

investigation into a specific subject"; "research has to do with answering a question in a scientific manner and the testing of an hypothesis"; "research is the attempting to discover new ideas and theories using certain methods".

The students were aware of the research that is being undertaken within the University through the various seminars and conferences, exhibitions and posters and were also aware of the specialist research units. However, students were less aware of research within their own department. The department was more vocationally oriented than other departments and was in the early stages of developing a research profile. Students had not routinely considered the research reputation of the department when deciding where to study, although some were aware of it, and in further discussion it was found that the uniqueness of the department in the sector had in fact been an influencing factor: "I didn't know the department rating, not sure it would have made a difference to studying here because the course is only available [here] at the moment". Some students would like to learn more about the staff's research provided that this research is relevant to their study and degree.

Students had a good understanding of how research can be incorporated into the curriculum, although experience varied between different approaches. These ranged from teaching about the research of others, "teaching courses based on up-to-date research, perhaps looking at differences of opinion between researchers", to teaching based on their own research, "the lecturer teaches subjects covered by their research and can bring in what and how they studied, what was found and any difficulties they encountered", to doing project-based work. Practical opportunities to engage in research were particularly welcomed by students: "It's definitely a good idea to have modules on the research process but it's only through doing research yourself that you learn how to do it." Carrying out an independent project was also thought to improve students' research skills as well as more transferable skills and overall was seen as a rewarding experience: "the dissertation was one of the most challenging but satisfying pieces of work during these three years".

Some students were more aware than others of an academic community within the department, but all agreed that there could be more encouragement to be actively involved. Some students felt that there could be more opportunities for students from different cohorts to come together and that specific activities aimed to integrate them in the community could be managed more effectively. Other students proposed that a seminar series specifically for undergraduate or postgraduate students or other forums could be developed where they could discuss research. Generally the students felt that the benefits of the community would be increased motivation and access to up-to-date knowledge and 'know-how'. It would also provide them with greater opportunities to discuss the practicalities of research and tap into the experience of staff more effectively.

Typically staff involved in research were perceived to be more passionate about their subject matter: "it often means that the teacher has more of a passion for the subject which means that it is easier to understand and can cause interesting debates"; "Research activities mean that lecturers are up to date in their knowledge"; "... when it comes to writing dissertations of any kind of research they are far more knowledgeable so they can help more". However, this perception was not necessarily linked to their own personal experience.

Again students were very much aware of the strain between the two roles of staff as teacher and researcher and that as a result their availability was sometimes restricted. Some students also commented on how integrating research activities in

teaching could be challenging: *“the module was quite advanced which is ok for people with research experience but challenging for those without”*; *“modules in the first year introduced the research process and that was helpful but it may have helped if the gap between that and conducting my own research was smaller”*.

6. Conclusions

It is important to note that the project explored the link between research and teaching with only a small group of staff and students in each of the six departments. Consequently the conclusions are specific to this particular project, and further studies would be required in order to identify any broader implications.

There was considerable consistency among the six departments with similar strategies cited repeatedly regardless of the particular science being studied. The departments were anonymised, and it was difficult to identify from the strategies adopted by staff which ones might be considered ‘hard’ or ‘soft’ sciences, a factor often taken into account in this debate. This consistency is worthy of further consideration particularly in relation to the discipline-based study conducted by Jane Robertson and Gillian Blackler (2006).

Two departments adopted a structured and progressive model, providing students with opportunities to engage consistently in the research process throughout their studies and building the necessary levels of student confidence gradually. For one department this approach had been designed in part to satisfy the requirements of a professional body, but was felt to have been genuinely embraced by staff. For the other department, it had not been a deliberate approach, but rather had emerged from the innovative teaching practices of staff and a willingness to engage students fully in the discipline at every level. Staff in these two departments were confident that effective links were made between research and teaching activities. It is worth recording that the largest response to the call for participants came from students in these two departments. It is also interesting that taken individually many of the approaches used by these departments were also evident in the other departments, but were not necessarily implemented in a cohesive way and did not constitute a strategic approach.

From the questionnaires and interviews it was clear that there are very few dynamic links made between institutional and departmental strategic planning documents for research and teaching. In the majority of cases the nature of the relationship between research and teaching was determined by individual practitioners. Although in practice there was a considerable degree of consistency in the approaches taken by staff within each department, the absence of a clearly articulated strategy for linking research and teaching meant that it was not easy for departments to recognise or promote good practice more widely. The lack of a strategy also meant that it was difficult to establish appropriate boundaries or to recognise constraints related to the discipline or curriculum within which staff could operate.

It was clear throughout the project that the language and terminology used to describe the relationship between research and teaching was problematic. The use of the ‘nexus’ and the different components of ‘research-led’, ‘research-informed’, ‘research-based’, ‘research-oriented’ and ‘research-tutored’ were felt to be confusing and distinctions between the different types of activity to be artificial. In addition it was often difficult to distinguish activities linking research and teaching from good and effective teaching more generally, and the justification for doing so was thought to be unclear. For example, although during the course of the interviews staff were

able to identify a range of approaches for using the latest research in their teaching, approaches that focused more on the process of research and equipping students with the skills to carry out research successfully were generally only teased out in discussion. Staff in several departments did not immediately recognise these types of activities as evidence of linking research and teaching. Consequently it was difficult to identify all the incidences where research and teaching are linked, and many examples will have remained unacknowledged.

Some members of staff were aware of a renewed external focus on the relationship between research and teaching. Several members of staff thought that more explicit structures to support research and teaching would be helpful, although there was a concern that the introduction of such structures should not be overly bureaucratic and that further research would be needed to identify suitable approaches.

The experience of students was generally very positive; even those who were most forthcoming with ideas to improve practice were able to draw on numerous examples of existing research-linked teaching in their department. Students appreciated the quality of research expertise available to them during their studies. Staff enthusiasm for research was applauded and felt to be “*contagious*”; a motivating factor for students to engage with particular topics or pursue further study. The students interviewed recognised the value of the skills they had acquired through research-linked activities and in fact demonstrated them during the focus groups themselves. In the constant drive for improvement and increased student satisfaction, it is easy to overlook the distance travelled and neglect to acknowledge the high level of practice that is already widespread.

7. Recommendations

This research project investigated the links between research and teaching and how these are enacted and experienced from both staff and student perspectives. It was a small-scale investigation carried out in science and engineering departments, and as a result the findings and conclusions may not be universally applicable. Nonetheless, we have proposed a number of recommendations that may be of value to others.

1. A departmental framework for developing the dynamic link between the strategic planning documents for research and teaching should be developed and mainstreamed.
2. Dissemination of research should be accessible to undergraduate and postgraduate students with regard to both content and presentation. For example, joint research events between staff and students could be used to raise awareness of research projects and engender confidence in students to contribute to the research community within the department.
3. Research activity and the links with teaching should be more actively promoted to students and made explicit in learning outcomes and departmental literature.
4. Research skills should be developed as part of a structured and progressive approach during the period of study taking into account discipline variation where necessary.
5. Programmes of professional development for academic staff should include explicit training on how to develop effective links between research and teaching activities.

6. The creation of, and effective use of, shared physical space in a department should be used to cultivate an effective academic community that fully engages both staff and students in an open and mutually beneficial dialogue.

Appendix A: Student questionnaires

The student responses to the initial questionnaire are provided in the tables below. It is important to note that the numbers of students involved in this project were small. It is also important to note that the questionnaires provide the initial response from students. When these responses were followed up in further discussions more information was elicited that sometimes clarified or contradicted the initial responses.

Student responses: undergraduates

| Group | 1 (%) | 2 (%) | 3 (%) | 4 (%) | 5 (%) | 6 (%) |
|---|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Research seminars/conferences | 100 | 82 | 100 | 94 | 88 | 40 |
| Notice boards advertising research opportunities | 80 | 82 | 71 | 81 | 75 | 60 |
| Existence of research units | 60 | 82 | 100 | 69 | 75 | 60 |
| Areas within the University with a national/international research reputation | 40 | 64 | 29 | 31 | 50 | 80 |
| Research posters/exhibitions/displays within the University | 80 | 64 | 43 | 75 | 63 | 20 |
| Research reports produced by the University | 60 | 45 | 43 | 63 | 38 | 60 |
| Books, journals articles output from University staff | 100 | 91 | 71 | 94 | 63 | 100 |

Table A1: Percentage of undergraduate students from each group aware of research activity at their university

| Group | 1 (%) | 2 (%) | 3 (%) | 4 (%) | 5 (%) | 6 (%) |
|--|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Hearing a member of staff discuss their research work in a module | 40 | 82 | 43 | 94 | 63 | 100 |
| Hearing a guest lecturer discuss their research work in a module | 0 | 55 | 14 | 38 | 13 | 60 |
| Reading a research paper or report written by a member of staff | 40 | 55 | 0 | 81 | 38 | 60 |
| Attending a University research seminar | 20 | 36 | 29 | 6 | 75 | 20 |
| Attending a research conference | 0 | 18 | 0 | 25 | 13 | 20 |
| Being a subject/participant in a research project run by a member of staff | 0 | 55 | 71 | 88 | 13 | 0 |
| Development of research techniques | 40 | 36 | 14 | 69 | 25 | 100 |
| Undertaking an independent research project | 60 | 55 | 57 | 81 | 63 | 60 |
| Undertaking a dissertation or thesis | 20 | 45 | 43 | 31 | 13 | 60 |
| Being involved in practical activities based on research projects | 20 | 45 | 0 | 50 | 0 | 40 |
| Acting as a research assistant | 0 | 18 | 0 | 13 | 0 | 0 |
| Contributing to a research conference paper or poster | 0 | 9 | 0 | 0 | 0 | 0 |
| Contributing to a research paper or other form of research output | 0 | 27 | 0 | 13 | 0 | 0 |

Table A2: Percentage of undergraduate students who have experienced research through teaching

| Group | 1 (%) | 2 (%) | 3 (%) | 4 (%) | 5 (%) | 6 (%) |
|--|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Undertaking a research degree | 20 | 55 | 57 | 63 | 75 | 100 |
| Undertaking non-funded personal research | 20 | 9 | 14 | 25 | 25 | 40 |
| Undertaking funded research | 0 | 73 | 43 | 63 | 38 | 40 |

| | | | | | | |
|--|-----|----|----|----|----|-----|
| Writing for publication | 100 | 73 | 43 | 63 | 63 | 100 |
| Supervising research students | 80 | 82 | 71 | 88 | 50 | 80 |
| Supervising research assistants | 20 | 45 | 14 | 6 | 38 | 0 |

Table A3: Percentage of undergraduate students aware of the research activities of staff who teach them

| Group | 1 (%) | 2 (%) | 3 (%) | 4 (%) | 5 (%) | 6 (%) |
|---|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Increased my understanding of the subject | 40 | 64 | 43 | 81 | 75 | 40 |
| Contributed to the development of my research-related skills | 60 | 55 | 14 | 75 | 14 | 40 |
| Increased my awareness of methodological issues | 20 | 55 | 29 | 63 | 29 | 60 |
| Stimulated my interest and enthusiasm for the subject | 40 | 55 | 71 | 44 | 71 | 0 |
| Motivated me to consider pursuing postgraduate research in the same area | 0 | 27 | 29 | 25 | 29 | 0 |
| Increased my awareness of the problems and issues faced by researchers | 60 | 55 | 71 | 56 | 71 | 40 |
| Motivated me to consider pursuing a career with a particular kind of research organisation or body | 20 | 27 | 29 | 13 | 29 | 0 |

Table A4: Percentage of undergraduate students believing research-led teaching has a positive impact on their learning

| Group | 1 (%) | 2 (%) | 3 (%) | 4 (%) | 5 (%) | 6 (%) |
|---|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Lack of availability of staff to see me | 0 | 18 | 14 | 25 | 13 | 20 |
| Apparent lack of interest by these staff in teaching and facilitating my learning | 0 | 18 | 14 | 13 | 25 | 0 |
| Apparent lack of interest by these staff in supporting my academic welfare | 0 | 9 | 0 | 6 | 13 | 0 |
| Apparent inability by these staff to explain concepts in ways in which I understand | 0 | 18 | 0 | 13 | 13 | 40 |
| Their research interests distort the content of what they teach | 0 | 9 | 29 | 19 | 25 | 20 |

Table A5: Percentage of undergraduate students believing research-led teaching has a negative impact on their learning

Student responses: postgraduate

| Group | 1 (%) | 2 (%) | 3 (%) | 4 (%) | 5 (%) | 6 (%) |
|---|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Research seminars/conferences | 100 | 100 | 100 | 100 | 100 | 100 |
| Notice boards advertising research opportunities | 100 | 80 | 67 | 100 | 33 | 60 |
| Existence of research units | 100 | 40 | 100 | 100 | 67 | 40 |
| Areas within the University with a national/international research reputation | 0 | 60 | 33 | 75 | 33 | 80 |
| Research posters/exhibitions/displays within the University | 100 | 80 | 100 | 50 | 67 | 20 |
| Research reports produced by the University | 0 | 60 | 100 | 25 | 33 | 20 |
| Books, journals articles output from University staff | 100 | 60 | 33 | 100 | 33 | 40 |

Table A6: Percentage of postgraduate students from each group aware of research activity at their university

| Group | 1 (%) | 2 (%) | 3 (%) | 4 (%) | 5 (%) | 6 (%) |
|---|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Hearing a member of staff discuss their research work in a module | 0 | 80 | 100 | 100 | 67 | 80 |
| Hearing a guest lecturer discuss their research work in a module | 0 | 20 | 67 | 75 | 0 | 80 |
| Reading a research paper or report written by a member of staff | 0 | 80 | 67 | 100 | 100 | 60 |

| | | | | | | |
|--|-----|-----|-----|-----|----|----|
| Attending a University research seminar | 0 | 60 | 67 | 100 | 33 | 20 |
| Attending a research conference | 0 | 0 | 33 | 25 | 0 | 0 |
| Being a subject/participant in a research project run by a member of staff | 100 | 100 | 67 | 75 | 67 | 80 |
| Development of research techniques | 67 | 80 | 33 | 50 | 0 | 60 |
| Undertaking an independent research project | 100 | 40 | 100 | 100 | 33 | 40 |
| Undertaking a dissertation or thesis | 100 | 100 | 100 | 100 | 67 | 80 |
| Being involved in practical activities based on research projects | 0 | 100 | 33 | 50 | 33 | 0 |
| Acting as a research assistant | 0 | 0 | 0 | 0 | 33 | 0 |
| Contributing to a research conference paper or poster | 0 | 0 | 0 | 0 | 0 | 0 |
| Contributing to a research paper or other form of research output | 0 | 0 | 0 | 0 | 0 | 0 |

Table A7: Percentage of students who have experienced research-led teaching

| Group | 1 | 2 | 3 | 4 | 5 | 6 |
|--|------------|------------|------------|------------|------------|------------|
| | (%) | (%) | (%) | (%) | (%) | (%) |
| Undertaking a research degree | 33 | 20 | 33 | 50 | 33 | 0 |
| Undertaking non-funded personal research | 0 | 0 | 0 | 50 | 33 | 0 |
| Undertaking funded research | 0 | 80 | 33 | 100 | 33 | 40 |
| Writing for publication | 100 | 60 | 67 | 100 | 67 | 40 |
| Supervising research students | 100 | 80 | 100 | 100 | 67 | 0 |
| Supervising research assistants | 33 | 80 | 33 | 100 | 33 | 0 |

Table A8: Percentage of postgraduate students aware of the research activities of staff who teach them

| Group | 1 | 2 | 3 | 4 | 5 | 6 |
|---|------------|------------|------------|------------|------------|------------|
| | (%) | (%) | (%) | (%) | (%) | (%) |
| Increased my understanding of the subject | 67 | 80 | 100 | 100 | 100 | 40 |
| Contributed to the development of my research-related skills | 33 | 60 | 100 | 50 | 67 | 20 |
| Increased my awareness of methodological issues | 33 | 80 | 67 | 50 | 100 | 40 |
| Stimulated my interest and enthusiasm for the subject | 33 | 80 | 100 | 100 | 67 | 20 |
| Motivated me to consider pursuing postgraduate research in the same area | 33 | 80 | 100 | 100 | 0 | 0 |
| Increased my awareness of the problems and issues faced by researchers | 0 | 80 | 67 | 25 | 33 | 20 |
| Motivated me to consider pursuing a career with a particular kind of research organisation or body | 0 | 40 | 67 | 25 | 33 | 0 |

Table A9: Percentage of postgraduate students believing research-led teaching has a positive impact on their learning

| Group | 1 | 2 | 3 | 4 | 5 | 6 |
|---|------------|------------|------------|------------|------------|------------|
| | (%) | (%) | (%) | (%) | (%) | (%) |
| Lack of availability of staff to see me | 0 | 20 | 0 | 0 | 0 | 20 |
| Apparent lack of interest by these staff in teaching and facilitating my learning | 0 | 20 | 33 | 25 | 0 | 0 |
| Apparent lack of interest by these staff in supporting my academic welfare | 0 | 0 | 33 | 25 | 0 | 0 |
| Apparent inability by these staff to explain concepts in ways in which I understand | 0 | 20 | 67 | 0 | 33 | 0 |
| Their research interests distort the content of what they teach | 0 | 20 | 33 | 50 | 33 | 0 |

Table A10: Percentage of postgraduate students believing research-led teaching has a negative impact on their learning

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