The Link between Research and Teaching in Architecture

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Abstract

In the current higher education climate, the link between teaching and the research that occurs in universities is a regular topic of debate. Research evidence suggests that this relationship is complex in nature and academics understanding of what is meant by the link between research and teaching vary. Within the subject area of Architecture, the relationship between teaching and research is particularly complex, given that academics are being encouraged to submit practice based (design) research as part of the UK's Research Assessment Exercise (RAE). Furthermore, the emphasis within schools of architecture on design project work is likely to provide opportunities for research to interact with student learning.

Through the use of case studies, a review of existing literature and an analysis of previous RAE submissions by schools of architecture, this paper evaluates the nexus between research and teaching in architecture, outlining how the disciplinary distinctions of the subject might impact upon the conception held on what is meant by linking research and teaching.

Keywords:

Research Teaching Nexus, Architectural Education, Design as Research, Curriculum Design

Introduction

In the current higher education climate, the link between teaching and the research that occurs in universities is a regular topic of debate. Universities achieving high ratings in research assessment exercises are able to attract higher proportions of university funding and as a result pressures are placed on academics to improve their research ratings. In many institutions there is a perception amongst academics that their promotional prospects will be greater if they concentrate effort on developing their research portfolios. More time spent on research may mean less time spent on teaching activities: yet there are many who believe that research can have a positive impact upon teaching, although this relationship is complex and there is no single mechanism by which teaching and research are linked. Many universities aspire to develop teaching that is 'research-led', 'research-informed' or 'research-based'. What is not clear is what is meant by these terms, as conceptions are likely to vary between individuals of different disciplines and different university roles.

The importance of the nexus between research and teaching, has historically influenced higher education policy internationally (Jenkins, 2004). In the UK, the 1963 Robbins Report (Robbins, 1963) on the future of higher education suggested that it was important for university staff to both teach and carry out research. In the US, The Boyer Commission (1990) promoted the concept of scholarship as a means to bring teaching and research closer. They concluded that educational provision could be enhanced by integrating undergraduate teaching with research activities and encouraging enquiry based learning. In New Zealand, higher education legislation specifically refers to the interdependence of research and teaching. More recently in the UK however, the 2003 white paper on the future of higher education cast doubt upon the importance of the research-teaching link, suggesting that it was not necessary to be involved in cutting edge research to be an excellent teacher (DfES, 2003). To support this claim, the UK government made reference to Hattie and Marsh's meta-analysis of 58 previous studies of the relationship between teaching and research carried out in US universities in the 1970s and 80s (Hattie and Marsh, 1996). This research concluded that the correlation between high quality research and high quality teaching was zero. The research was taken as evidence that research funding should be targeted towards specialist research universities, whilst other universities should be encouraged to specialise in teaching. To some extent this interpretation did not fully reflect Hattie & Marsh's conclusion, which actually suggested that the link between learning and teaching should be improved (Jenkins, 2004; Hattie and Marsh, 2004). Furthermore, studies in the UK suggest that at an institutional level, correlations exist between scores in research and teaching assessments (Jenkins, 2004).

This paper evaluates the nexus between research and teaching in architecture, outlining how the disciplinary distinctions of the subject might impact upon the conception held on what is meant by linking research and teaching. It is based upon a premise that the relationship between teaching and research is complex and that there is evidence to suggest that if links are desired, then they have to be created, and where this happens there can be benefits for student, teacher and researcher (Jenkins, 2004). The paper initially reviews literature on the

nature of the link between research and teaching generally. It then looks specifically at the nature of research, teaching and learning in architecture, in doing so it addresses the often contested nature of design as research. In order to gain an understanding of the relation between research and teaching in architecture, a series of case studies are analysed in the light of the literature reviewed.

The Complex Nature of the Research-Teaching Nexus

Before we can understand the disciplinary nature of the research-teaching nexus, it is useful to outline how research and teaching might interact. Key to this is an understanding of the change in the way that knowledge itself is perceived by society (Barnett and Griffin, 1997). A traditional view is one where research leads to the acquisition of new, measurable descriptions of reality, where results must be objective, rational and reproducible (Brew, 1999). Many authors have suggested a paradigm shift in the way that knowledge is created, moving towards an interpretive, practice-based means of knowledge creation, something that Gibbons *et al.* (1994) referred to as mode 2 knowledge. This recognition of wider definitions of knowledge creation is likely to be reflected in how we conceive the link between research and teaching (Brew, 2002). For instance, a basic conception of the link between research and teaching might be students learning about the results of a piece of research. An alternative conception might involve students developing the intellectual and interpretive capacity required for so called mode 2 research.

As a result of a phenomoenographic study of 57 academics in a range of disciplines, Brew (2001) suggests that individual researchers' conceptions of what is meant by research could be identified as four distinct types:

- **Domino:** research consists of the discovery of a series of atomistic research findings, and synthesis, often in a linear fashion

- **Layer:** where research attempts to discover hidden meanings within the data

- **Journey:** where research is conceived as an aspect of personal development within the researcher

- **Trading:** where the emphasis of the research is on end products such as publications and esteem.
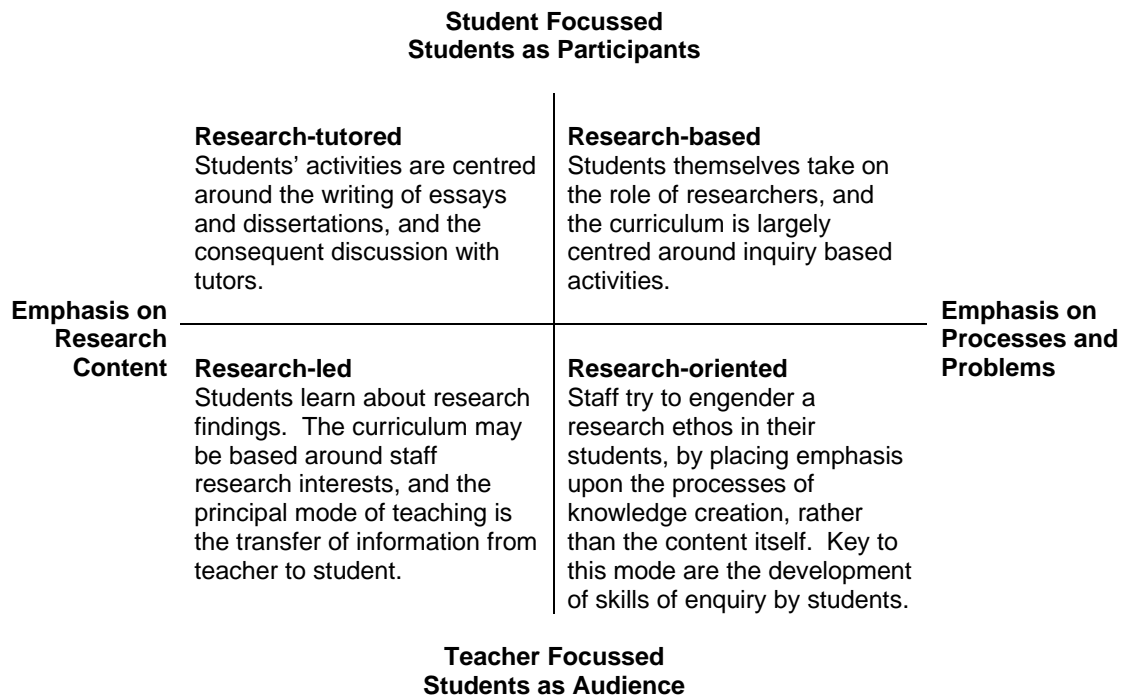
Brew (2002) suggests that these conceptualisations would lead to different manifestations of the research teaching link. So, for example, a teacher with a trading view of research might place emphasis upon involving students in social activities perhaps similar to a research conference (writing papers, giving presentations). A teacher with a layer view might place a greater emphasis on developing students' research methodology, interpretation skills etc.

In a similar way different conceptions of teaching may impact upon the link between research and teaching. Prosser and Trigwell (1999) highlight the different conceptions of teaching that are commonly held by academics, and relate these to the approaches that teachers take in their teaching. These range from the teacher focussed, information transfer model, where

the teacher sees education as the process of transfer of knowledge between the teacher and the student. A teacher with this conception of teaching may see the link between research and teaching as one of passing on the knowledge created in their research to the student. An alternative conception of teaching, often connected with the constructivist school (Biggs, 2003; Prosser and Trigwell, 1999; Ramsden, 2003) suggests that learning is about changing the student's conceptions of the world, a more student focussed viewpoint. The link between research and teaching may manifest itself through student centred activities, such as problem based learning, where the students become responsible for developing their own construction of that which they are learning.

Zamorski (2002) makes a similar distinction in terms of whether students are passive to the research process, typical of a teacher focussed, information transfer approach, and an active approach, typified by a student centred approach to connecting research and teaching. Her research suggests that whilst students appreciate the value of working within a research environment, a passive approach may lead to them feeling excluded from that research,

As a result of a combination of an individual's conception of teaching and research, the research teaching nexus may manifest itself in a number of ways. Healey (Healey, 2005, Healey and Jenkins, 2006) has developed a model that outlines the principal characteristics of the teaching research nexus (see Fig 1). This model recognises two principal dimensions: the extent to which the educational activities are teacher or learner focussed, and the extent to which the emphasis is on the research content itself, or upon the problems and processes associated with carrying out the research. This leads to four types of possibilities for the link between research and teaching: 'research-led', 'research-oriented', 'research-based' and 'research-tutored'.

Student Focussed
Students as Participants

	Research-tutored Students' activities are centred around the writing of essays and dissertations, and the consequent discussion with tutors.	**Research-based** Students themselves take on the role of researchers, and the curriculum is largely centred around inquiry based activities.	
Emphasis on Research Content			**Emphasis on Processes and Problems**
	Research-led Students learn about research findings. The curriculum may be based around staff research interests, and the principal mode of teaching is the transfer of information from teacher to student.	**Research-oriented** Staff try to engender a research ethos in their students, by placing emphasis upon the processes of knowledge creation, rather than the content itself. Key to this mode are the development of skills of enquiry by students.	

Teacher Focussed
Students as Audience

Figure 1 Healey's model of the Teaching-Research Nexus

Architecture as a Discipline

A key aspect of the debate about the relationship between teaching and research is the extent by which this connection is shaped by the individual discipline. Griffiths (2004) for instance, outlines the specifics related to Built Environment Education. Becher and Trowler (2001) suggest strong differences exist between the nature and values held within individual disciplines, but do these make a difference in how the link between teaching and research is manifested? Brew's research on conceptions of research (Brew, 2001) concluded that the different conceptions of research transcended the disciplines. Nevertheless, Colbeck's research which specifically looked at the integration of teaching and research in Physics and English departments suggests that key differences exist between how departments link teaching and research (Colbeck, 1998).

The nature of research in architecture

The research-teaching link in architecture is likely to be particularly complex given the multi-disciplinary nature of the subject (QAA, 2000). There is no single specific research methodology that might typically be used, rather architecture utilizes and applies the methods and knowledge base of other discipline areas, including the human and physical sciences, the humanities and the fine and applied arts. As with other built environment subjects, research is likely to relate to application of knowledge, rather than the generation of new knowledge (Griffiths, 2004). Researchers may apply principals from pure science, for instance by investigating how buildings respond to environmental and climactic influence, they may apply principals of philosophical thinking to architecture, or they may use techniques of the historian or social scientist.

Rendel (2005) following on from research carried out by Jenkins *et al.* (2006, 2004) suggested four principal areas in which architectural research occurs: Building Science, Social Science, Humanities and Art and Design, noting that the former typically attracted the highest degree of research funding, whilst the latter receives considerably little. These areas are further categorised by Griffiths (2004) who makes the distinction between empirical science and interpretive investigation as particular approaches to research. The former refers to a search for general explanations and is typically associated with the natural sciences and sometimes social sciences. This approach to research is more likely to be adopted by those involved in building science research. This may typically involve the quantitative measurement and monitoring of some phenomena, and is often hypothesis-led and adopts methodologies that would traditionally be regarded as following sound scientific practice.

Interpretive investigation is more typical of those academics engaging in arts and humanities research, but also in some cases the social sciences. Rather than focussing upon a search for objective findings, it focuses upon a search for meaning based around how individuals interpret the world (Proudfoot, 2000) and is often centred around contested topic areas. This approach takes exception with the idea that the subject under investigation is independent of the perceptions and interpretations of the researcher. Typically work in this area is qualitative in nature.

In order to gain a clearer understanding of the nature of research within schools of architecture, an analysis was carried out of submissions for the 2001 UK Research Assessment Exercise (HERO, 2001). This was done by categorising each research output submitted by individual academics, based upon its title. Table 1 gives an indication of the principal areas submitted.

Table 1 Percentage of research outputs submitted by schools of architecture for the 2001 Research Assessment Exercise

	Built Environment Unit of Assessment	Art and Design Unit of Assessment
Number of schools of architecture submitting	18 (809 Submissions)	7 (181 Submissions)
Humanities (including history, theory and the cultural context of architecture)	39%	49%
Building Science (Including environmental science and building technology)	33%	14%
Design	8%	22%
Other, including Management, Practice & Law, Design Methods, and Pedagogic Research	11%	13%

The data suggests that the Humanities and Building Sciences constitute the largest proportions of research outputs in architecture. The Art and Design Panel also received a number of submissions that might be described as practice based research, where research is carried out through design. Referring specifically to research in art and design fields Frayling (1993) distinguished between research 'into' design, research 'for' design and research 'through' design. In this model, research into design comprises the historical and theoretical analysis of existing designs. Research 'for' design could be conceived as being the application of knowledge to design. Research 'through' design suggests that the processes of designing represent a research methodology in itself.

There were relatively few submissions of design as research to the Built Environment Panel. Steadman and Hillier (2003) suggest that this is a result of a perception that non-traditional research would not be considered acceptable. This may change in the 2008 research assessment exercise as the panel are actively requesting practice based research to be submitted (HEFCE, 2006). Contrary to Rendel's categorisation, the data suggests that there was relatively little activity in the social science areas within architecture.

Griffiths also recognises that much research occurring in Built Environment schools adopt what might be considered by those outside the discipline to be less rigorous, even messy methods, although the intellectual challenge may be just as great. The research is often

multi, inter or trans-disciplinary and may not even occur within the confines of a university, but rather in the studios of practicing architects.

Design as research

Many teachers of architecture are also practitioners of architecture. Their work may not necessarily lead to the generation of new, testable knowledge, but may lead to acts of innovation which could be considered as having research merit. The process of designing is one of synthesis and integration of knowledge from a variety of sources, something that Boyer (1990) refers to in other fields as the scholarship of integration. Nevertheless, the concept of design as research raises considerable contention; Yeomans (1995) for example considers design to constitute consultancy, rather than research, Griffiths (2004) however considers consultancy to be a particular form of applied research. Lawson (2002) argues however, that providing that the design has expanded the boundaries of knowledge beyond the basic solution of local problems, then it should be considered as research. Similarly Till *et al*. (2006) suggest that practice based research is valid but should not be exempt from the rigour of traditional research Given that design is central to architectural education, design as research could represent an important connection between research and teaching. Furthermore, the academic design studio could become the venue for practice based research, carried out in collaboration with students: The work carried out in architecture schools' studios, could become a vehicle for the development of integrative research. Lawson for instance suggests that:

> Surely, if the idea here is that research-led teaching is taking place through design then those ideas should be given a wider audience than just the university studio or the design practice? (p113).

This would perhaps be an example of research being led by teaching, something that Jenkins *et al.* have suggested is being sought by some schools of architecture.

Teaching and learning approaches

The principal vehicles for the integration of research and teaching within the architectural curriculum are likely to be through design studio teaching, or through more traditional pedagogical methods such as lectures and seminars. Design studio teaching is generally considered to be student centred, and inquiry based, with an expectation of self-discovery on the part of the student. The earlier arguments concerning whether design could be considered to be research apply here, and it is possible that activities undertaken by students within the design studio do constitute some form of research. This would suggest that according to Healey's model, design teaching might be described as being 'research-based'.

Some aspects of architectural knowledge – including history, theory, legislation, the regulatory system and the principles of structure, environmental science and construction, are often learned through structured reading, lectures and seminars. These topics may respond to a teacher's research area, but as they are carried out outside the design studio,

may in some cases adopt an information-transfer, rather than an inquiry based approach. According to Healey's model these might be considered to be 'research-led'.

Students commonly have to undertake a written special subject or dissertation. This enables the students to explore knowledge in a particular area, and to develop key research skills. This is likely to be 'research-tutored', although to a certain extent is likely to be 'research-based'.

Architectural education is generally considered by both its teachers and students to be a vocational subject. The content of its curriculum is to a great extent underpinned by the requirements of professional accrediting bodies for a breadth of delivery reflecting the nature of the subject. Jenkins *et al.* (2004) suggest that schools perceive a tension between the need to teach a broad syllabus, and the desire to research a topic in some depth. There is often perceived to be little space in the curriculum for staff research agendas to be pursued in any great depth, particularly if those agendas do not coincide with the contents of the professional syllabus. Furthermore, it may be difficult for schools to have a breadth of research that covers the full breadth of the professional syllabus, so some areas would not be taught by those at the 'cutting edge of research. One further implication of the need to develop a depth of research is that schools are commonly employing non-research active staff (including part-time practitioners) to deliver design teaching. This is considered to be good for professional education, but may place a barrier between teaching and research. At the same time, a number of schools of architecture have established specialist research units whose focus is on the generation of research income and outputs, and staff working in these areas are more likely to make substantial contributions to specialist postgraduate teaching rather than more general undergraduate studies. Evidence from the 2001 Research Assessment Exercise Submission for unit 33 (Built Environment) (HERO, 2001) suggested that those schools that returned a high proportion of outputs related to building science often had dedicated research groups in this area.

Case Studies

The Centre for Education in the Built environment has commissioned a series of case studies where academics have attempted to evaluate the nexus between their research and their teaching. These participants were selected as a result of an open call. Participants were asked to identify an element of their research interests and to consider how this might be incorporated into their teaching. They were asked to provide a programme for the potential integration of research and teaching, and then implement that plan. They were also asked to provide an evaluation of the consequent student experience.

The research teaching nexus was analysed in terms of Healey's model of the research-teaching nexus shown in Figure 1, categorising the relationship between research and teaching as research-based, research-led, research-oriented, or research-tutored.

The five case studies provided do not necessarily represent an accurate picture of the nexus between research and teaching in architectural education, and there are probably many more examples of research being used to inform the content of a course. What the case

studies do provide are useful examples of the range of interpretations and means of developing the teaching-research link.

Case Study 1: Digital Design and Cinematics, University of Newcastle

Research Informing Project: Research at the University of Newcastle had lead to the development of software for the real-time visualisation of architectural proposals. The software was used in teaching with the intention that this would provide a valuable opportunity to test the software and to understand the benefits of using a new approach to design that uses the software. It was hoped that the students' experience could further inform the development of the research.

Nature of the Research: The research underpinning this case study could be classified as applied research. It investigates how existing software can be developed to meet the needs of architects and provides a tool that architects can use when evaluating their buildings.

Teaching and Learning Method: The teaching formed part of an M.Sc course in Digital Architecture. It was also an optional element of a Part 2 Architecture course. The course is conducted in the design studio with the aim to develop students' understanding of and skills related to advanced visualisation techniques. The students were asked to use the software to create an architectural walkthrough of a virtual environment that they had created. The students were provided with the lecturer's publications and were asked to be critical about the research frameworks suggested.

Learning Approach (Student Centred or Teacher Centred): Whilst there was some attempt by the lecturer to instil some theoretical knowledge in the students, the educational experience was typically student centred and inquiry based, with the students using the developed software to explore their own ideas.

Focus of Research (Content Centred or Method Centred): The student activities were closely related to the tutor's research area, nevertheless, students were expected to actively engage with the subject of the research and emphasis was placed upon research processes and problems.

Categorisation: *Research-based,* possibly *research-tutored,* as teaching was student centred: students were engaging with research processes and in some cases with the tutor's research content as well.

Direction of Relationship: The investigator considered this to be *bi-directional*, in that the students provided valuable data which could further the research development.

Evaluative Comments: The investigator claimed that the students appreciated being involved with what they saw as cutting edge research. The hands-on approach was particularly appreciated. The investigator felt that it was important to be clear to students as to their role in the research project, and how research and teaching would link. He also suggested that achieving a close relationship between research and teaching was to some extent made easier by having a low staff-student ratio.

Case Study 2: Perfomative Architecture (Exhibition Design), University of Nottingham

Research Informing Project: The case study built upon a tutor's research interests in exhibition design, which looks at relationship between built form, the objects being exhibited and how individuals perceive and respond to the space (Dernie, 2006).

Nature of the Research: The research underpinning this case study could be classified as applied research. The investigator was interested in how theoretical ideas can be translated into practice.

Teaching and Learning Method: The project was undertaken by 30 diploma (ARB Part 2 exemption) students, who pursued the tutor's ideas through a series of design projects. These included the building of an exhibition stand for the 2005 Prague Biennale; a series of urban interventions and the development of a video highlighting the process that they had undertaken. The aim of the exercise was for the students to develop new ways of thinking about architecture in terms of how it performs and is constructed and the students had to apply the tutor's theoretical research to their design project work. A series of seminars were conducted which ran alongside the design project work; these were intended to help students gain a better understanding of the research.

Learning Approach (Student Centred or Teacher Centred): Although students had to attend seminars on the tutor's research, most of their activities could be described as student centred as the students were working independently or in groups.

Focus of Research (Content Centred or Method Centred): In this case the research content and theories were largely determined by the tutor. The students were expected to apply those ideas to reality.

Categorisation: *Research-tutored* as students were engaging with the research topic of their tutor but in an enquiry-based manner.

Direction of Relationship: *Two-way*, the tutor claimed that the students' investigations helped him to further his own research.

Evaluative Comments: Initially students had some difficulties in comprehending the theoretical nature of the research and applying it to their project work, however in some cases towards the end of the project, students started to recognise new ways to think about their designs. In all cases the exercise was seen as intellectually challenging.

One additional benefit from the tutor's perspective was that he felt that he had learned how to communicate research to the students.

Case Study 3: Linking Landscape Research and Teaching, Newcastle University

Research Informing Project: The students' activities were centred around their tutor's research into the impact on the landscape of wind farms and other renewable energy sources.

Nature of the Research: The research underpinning this case study was largely a series of meta-analyses of other research, which focussed upon the collation and analysis of a disparate variety of sources.

Teaching and Learning Method: Students were initially asked to participate in a paper-based exercise where they reflected upon their perceptions and pre-conceptions of the nature and purpose of research. In the second stage the students attended lectures and classes about research, which used the tutor's research as a case study on how to develop research. The final assignment required students to use the research skills that they had developed to demonstrate how they might assess information to support a controversial application for planning consent.

Learning Approach (Student Centred or Teacher Centred): The project specifically aimed to give students a better understanding of the relationship between research and teaching and to encourage students to develop a critical awareness of research methods and results. Although students received lectures in the subject area related to their tutor's research, they also had the opportunity to construct their own knowledge through the pursuit of a scenario based assignment.

Focus of Research (Content Centred or Method Centred): The aim of the teaching was not to transmit the content of the research to the students but rather to encourage them to gain an understanding of research methods used. Emphasis was placed upon *how* students would find appropriate information, rather than the information itself.

Categorisation: *Research-oriented* as the teaching activities were specifically about developing particular research skills*.*

Direction of Relationship: In this case there was a *one-way* relationship between research and teaching, with students making little contribution towards their tutor's research project.

Evaluative Comments: Whilst a number of students performed as anticipated, interestingly some students failed to understand that the exercise was about research methods and focussed excessively on the content of the research. Students tended to view the information presented to them uncritically. Questions were raised as to why this might have been; did students not see research as relevant on a professional course, or were they too immature to cope with the exercise.

Case Study 4: Wall Workshop, University of East London

Research Informing Project: The research programme investigated innovative full scale concrete casting techniques. New methods for mixing and pouring concrete are trailed, including innovative designs for formwork.

Nature of the Research: Applied Research which is carried out through the process of designing.

Teaching and Learning Method: Students were expected to develop and try different techniques for casting concrete, and develop critical judgement over the innovations that

they had generated. The students developed an initial thesis related to the requirement to build a wall, and used the investigation to prove or disprove this thesis. In addition to the project aim of engaging students in the research, the project also aimed to help students gain an understanding of the materials that they were working with and to encourage team working skills.

The teaching took the form of a single workshop event, following which students were asked to reflect upon the value of the workshop in developing an understanding of research issues. The project was not assessed, which encouraged discovery and curiosity. The project was undertaken by 21 diploma (ARB Part 2 exemption) students.

Learning Approach (Student Centred or Teacher Centred): The approach to the learning experience was very much student centred and inquiry based, with students experimenting with novel approaches.

Focus of Research (Content Centred or Method Centred): The focus was on the students directly engaging with the research techniques that had been used, rather than being taught about the findings of the previous research. The academic staff provided a general orientation and attitude to the learning.

Categorisation: The relationship could be described as *research-based* in that the curriculum was designed around inquiry based activities, and that the role of the teacher was working as an equal with the student.

Direction of Relationship: *Two-way*, to a limited extent the students were able to contribute towards the research findings of the tutor.

Evaluative Comments: Whilst some of the results were very positive, some students felt that there was insufficient time to gain an understanding of the initial research work carried out by the course tutor. Similarly the investigator felt that as a result of pressures of time, students were unable to engage in a more open-ended approach to research.

Case Study 5: Evidence-Based Design, Cardiff University

Research Informing Project: None specifically – students set their own agenda.

Nature of the Research: Design as Research: it is part of the school's mission to investigate research through design, which it pursues through its Design Research Unit.

Teaching and Learning Method: This is the major thesis for all students studying for the M.Arch (ARB Part 2 exemption) at the Welsh School of Architecture. Students are asked to make propositions for the design of a piece of architecture, but in the light of the development of a personal thesis that they choose to explore. Students' design decisions are expected to be informed by this thesis, and the design process is seen as a means by which students can explore their thesis. Prior to commencing their design project work, students undertake a 'primer' project where they can explore their thesis in some detail. Students are made aware that architecture is a research activity and that design propositions should demonstrate the research which underpins them in all respects. The design process

is seen as a means of exploration of their thesis and students document their research findings in a design diary.

Learning Approach (Student Centred or Teacher Centred): The students are assigned individual tutors, who set an overarching the theme for their student groups (such as landscape) but the students set their own thesis topic and agenda within that theme.

Focus of Research (Content Centred or Method Centred): Students do not apply a traditional 'scientific' research methodology and emphasis is placed upon synthesis and innovation. Whilst the students work in thematic studios under the guidance of a tutor, the topics that the students choose to address are not necessarily the research topics of their tutors.

Categorisation: Students work in an inquiry based manner, with little teacher dictated content suggesting a *research-based approach.*

Direction of Relationship: *Two-way,* the school's design research unit (which often employs recent graduates) benefits from the students' design research.

Evaluative Comments: Whilst it becomes apparent that those students who pursue an evidence-based approach to their design project work, benefit in terms of the quality of their output, the weaker students seem less able to engage with this approach and ethos towards design.

Discussion

All of the chosen case studies suggested that the tutors had adopted a student centred approach. None of the participants expressed a desire to transmit the content of their research to their students. Nevertheless, in the case of the landscape project, it was apparent that some of the students perceived that the purpose of the project was for them to learn about their teacher's research. The teachers in this case were attempting to engage the students in the process of research. This project was the only one where students were expressly asked to think about the process of research: research methods became the purpose of the teaching per-sec. In the other projects, the research undertaken by the students was a means to developing some other learning outcome. For instance in the case of the Wall workshops, this was an understanding of materiality, in the cinematics project, research became a means by which students could reflect upon their design proposals.

The evidence-based design at the Welsh School of Architecture was the only one where the topic of the students focus was not necessarily based around the research carried out within the school. The students had a free choice for their subject of investigation, and even the methodologies adopted did not necessarily relate to those commonly used by researchers in the school. Here the emphasis was to a much greater extent building on the research ethos held by the school. In this way, the link between research and teaching would be described by Griffiths (2004) as diffuse, but still strongly integrated. The teaching recognises the value to the profession of architecture (into which the majority of students will progress) of an

evidence based approach to architectural design, where decisions are informed by evidence, rather than intuition.

Healey's model referred to earlier of the teaching research nexus provides a useful means to distinguish the complexity of the link between research and teaching, although the majority of the cases included here to some extent fall under the heading of Research-based, where students effectively take on the role of researchers. Nevertheless, in all of these cases, an assumption is made that designing does constitute researching. This may be the case for certain students, but not with others. In the landscape project, there is some evidence to suggest that the relationship between research and teaching would be Research Orientated, with the emphasis being placed on staff engendering a research ethos in students. Unlike the Cardiff case study, the Nottingham project focussed upon specific content related to the researcher's interests, and could therefore fall under the heading of 'research-tutored'. A similar relationship might exist in the design units that occur in certain schools of architecture, where a group of students work with a tutor to explore that tutor's specialist interests through design. Nevertheless, Healey's description of what is meant by 'research-tutored' inaccurately describes the nature of the link between research and teaching in this particular project, as the outcomes are not essays or dissertations – but rather an intellectual process informing design. The term 'research-tutored' in Healey's model was originally conceived to describe the type of tutorial typically found in Oxford colleges. It is possible that model may need to be adapted to reflect the specific nature of the discipline of architecture, in order to distinguish between situations where students apply and interpret a tutor's research interests into their design thinking, and where students are undertaking more self-determined research through design.

None of the case studies fell into the category of research-led, where emphasis is upon the transfer of content between tutor and student.

Student Focussed
Students as Participants

	Research-tutored Students apply or interpret research content and ideas of tutors through their project work.	Research-based Students use the process of designing as a means to advance and develop knowledge.	
Emphasis on Research Content	Research-led Students learn about research findings through transmission, for instance through lecture courses that are not related to design project work.	Research-oriented Students are encouraged to develop research skills and design enquiry and related information gathering skills through focussed teaching.	**Emphasis on Processes and Problems**

Teacher Focussed
Students as Audience

Figure 2 Modified version of Healey's Model accounting for the research-teaching design project work

Conclusions

The research teaching link represents more than simply the delivery of research content into the curriculum. Design project work typically requires the student to adopt an inquiry based approach to learning, which will often involve the undertaking of research type activities. Design project work rarely can be described as following an information transfer model of education, and indeed a key characteristic of the link between research and teaching in this area may well represent a mismatch between the research interests of a teacher (if they exist at all), and the subject of enquiry undertaken by the student. In terms of Healey's model, teaching of this type could be described as being research-based – whereby a student uses research methods, but does not replicate the content of departmental research. But does student project work really constitute research? It is common to hear students say that they have been researching, but in reality, this commonly involves the assemblage and presentation of a series of disparate elements. Perhaps the distinction made by Lawson (2002) between design as research, and design as consultancy has some resonance here. If student work has expanded the boundaries of knowledge beyond the basic solution of local problems, then it should be considered as research. The acceptance of design based materials as part of the 2008 RAE exercise may encourage tutors to promote project work that does push intellectual boundaries. Furthermore, a number of schools of architecture are currently promoting postgraduate qualifications through design, rather than traditional research methods, with the principal intention of encouraging research through design.

It may be a common perception that linking research and teaching is about presenting the findings of research to students. This paper has suggested that in reality this relationship is more complex than this perception. Furthermore, evidence from the case studies suggests that students value being able to participate in the research process as well as recognising that they were working within what they considered to be cutting edge research, rather than being passive observers of it. This mirrors the findings of Zamorski (2002). Nevertheless, it was clear that the relationship was misconceived by certain students, perhaps those that viewed teaching as a process of transmission.

One issue particular to architectural education is the students' participation in design project work, which in certain cases may constitute a process incorporating a number of elements that might also be found in research. The making and testing of propositions based upon evidence derived from experimentation as well as library resources is commonly found within architectural education. This might suggest that the link between research and teaching in architecture is relatively strong, but might not necessarily confirm to the common understanding that the research-teaching nexus is about delivering your research.

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References

Barnett, R. & Griffin, A. (1997). *The end of knowledge in higher education.* London: Cassell.

Becher, T. & Trowler, P. (2001). *Academic tribes and territories: Intellectual enquiry and the culture of disciplines.* Buckingham: Open University Press.

Biggs, J. B. (2003). *Teaching for quality learning at university: What the student does.* Buckingham: Open University Press.

Boyer, E. L. (1990). *Scholarship reconsidered: Priorities of the professoriate.* Princeton, N.J.: Carnegie Foundation for the Advancement of Teaching.

Brew, A. (1999). Research and teaching: Changing relationships in a changing context. *Studies in Higher Education, 24* (3), 291-301.

Brew, A. (2001). Conceptions of research: A phenomenographic study. *Studies in Higher Education, 26* (3), 271-285.

Brew, A. (2002). Enhancing the quality of learning through research-led teaching. Paper presented at *Quality Conversations: HERDSA Conference*, Perth, 7-10 July 2002.

Colbeck, C. L. (1998). Merging in a seamless blend: How faculty integrate teaching and research. *Journal of Higher Education, 69* (6), 47-71.

Dernie, D. (2006). *Exhibition design.* Amsterdam: BIS.

DfES. (Department for Education and Skills). (2003). *The future of higher education.* London: TSO.

Frayling, C. (1993). *Research in art and design.* Royal College of Art.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. & Trow, M. (1994). *The new production of knowledge.* London: Sage.

Griffiths, R. (2004). Knowledge production and the research-teaching nexus: The case of the built environment disciplines. *Studies in Higher Education, 29* (6), 709-726.

Hattie, J. & Marsh, H. W. (1996). The relationship between research and teaching: A meta-analysis. *Review of Educational Research, 66* (4), 507-542.

Hattie, J. & Marsh, H. W. (2004). One journey to unravel the relationship between research and teaching. Paper presented at *Research and Teaching: Closing the Divide? An International Colloquium,* Winchester, March 18-19.

Healey, M. (2005). Linking research and teaching: Exploring disciplinary spaces and the role of inquiry-based learning. in Barnett, R. (Ed.). *Reshaping the university: New relationships between research, scholarship and teaching.* Maidenhead: Open University Press. pp 67-78.

Healey, M. & Jenkins, A. (2006). Strengthening the teaching-research linkage in undergraduate courses and programs. in Kreber, C. (Ed.). *Exploring research-based*

teaching: New directions for teaching and learning, no. 107. Chichester: Jossey-Bass Wiley. pp 45-56.

HEFCE. (Higher Education Funding Council for England). (2006). *RAE 2008, panel criteria and working methods: Panel h.* Bristol: HEFCE.

HERO. (2001). *2001 research assessment exercise: The outcome*: HERO. URL: http://www.hero.ac.uk/rae/Pubs/4_01/ (accessed 22 Oct 2007).

Jenkins, A. (2004). *A guide to the research evidence on teaching-research relations.* York: Higher Education Academy. URL: http://www.heacademy.ac.uk/resources/detail/id383_guide_to_research_evidence_on_teaching_research_relations

Jenkins, P., Forsyth, L. & Smith, H. (2004). *Balancing three dimensions in research: Depth, breadth and length. An institutional analysis of research in architecture in the UK higher education sector: Report on the UK-wide research.* Edinburgh: Edinburgh College of Art.

Jenkins, P., Forsyth, L. & Smith, H. (2006). Research in UK architecture schools; an institutional perspective. *arq: Architectural Research Quarterly, 9* (01), 33-43.

Lawson, B. (2002). The subject that won't go away but perhaps we are ahead of the game. Design as research. *arq: Architectural Research Quarterly, 6* (02), 109-114.

Prosser, M. & Trigwell, K. (1999). *Understanding learning and teaching: The experience in higher education.* Buckingham: the Society for Research into Higher Education & Open University Press.

Proudfoot, P. (2000). Structuralism, phenomenology and hermeneutics in architectural education. *International Journal of Architectural Theory, 5* (2), URL: http://www.tu-cottbus.de/BTU/Fak2/TheoArch/Wolke/eng/Subjects/002/Proudfoot/proudfoot.htm (accessed 29 October 2007).

QAA. (Quality Assurance Agency). (2000). *Benchmark statement for architecture, architectural technology and landscape architecture.* Gloucester: QAA.

Ramsden, P. (2003). *Learning to teach in higher education.* New York ; London: Routledge/Falmer.

Rendell, J. (2005). Architectural research and disciplinarity. *arq: Architectural Research Quarterly, 8* (02), 141-147.

Robbins, L. (1963). *Report from the committee on higher education.* London: HMSO.

Steadman, P. & Hillier, B. (2003). Research assessment under the microscope: Disturbing findings and distorting effects. *arq: Architectural Research Quarterly, 6* (03), 203-207.

Till, J., Mottram, J. & Rust, C. (2006). Adapting research activity AHRC review of practice-led research. *arq: Architectural Research Quarterly, 9* (02), 103-104.

Yeomans, D. (1995). Can design be called research? *arq: Architectural Research Quarterly, 1* (1), 12-15.

Zamorski, B. (2002). Research-led teaching and learning in higher education: A case. *Teaching in Higher Education, 7* (4), 411-427.