



Exploring the Understandings and Perceptions of Research- Teaching Linkages amongst UCD Faculty

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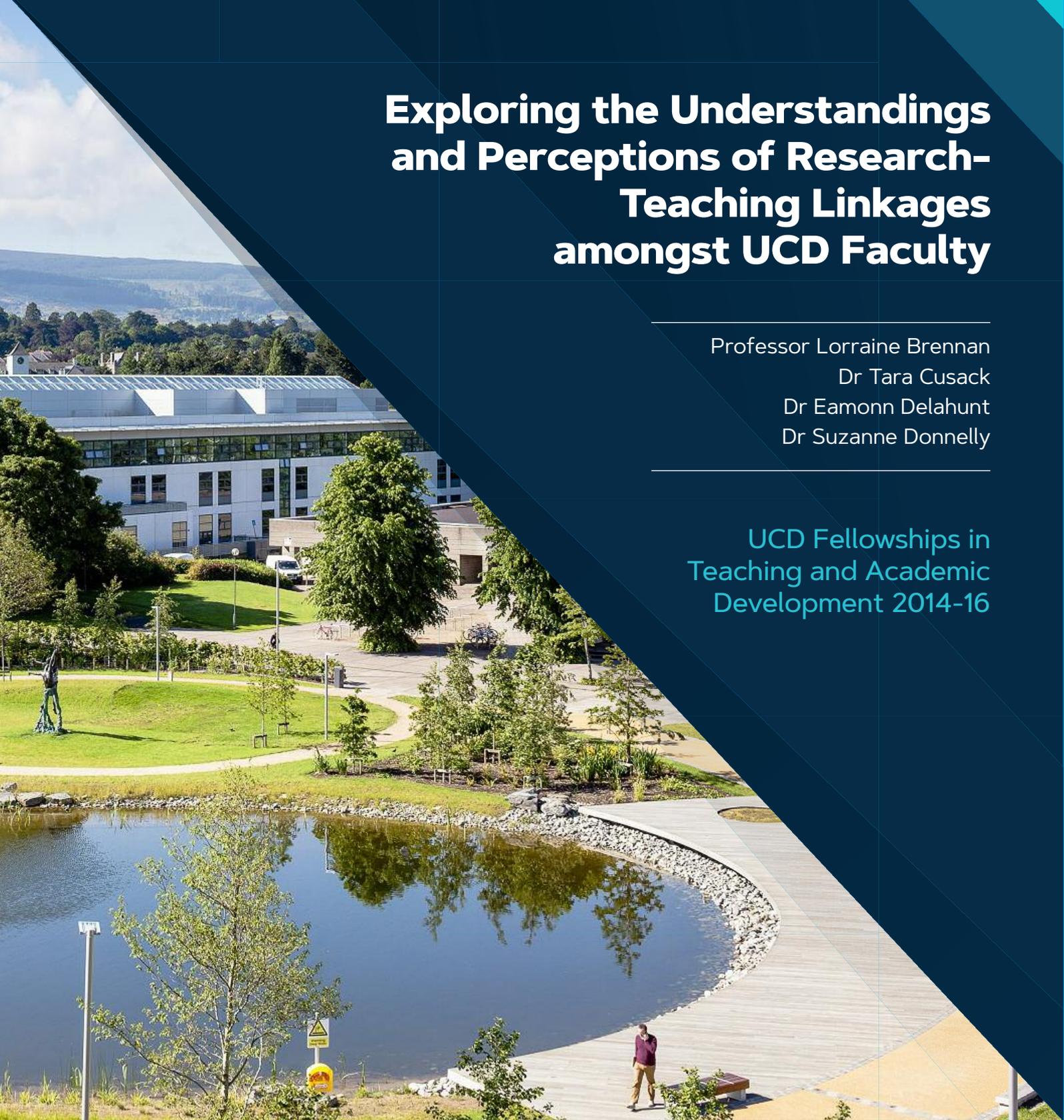


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Executive Summary

The University College Dublin (UCD) Strategy (2015 – 2020) articulates six major initiatives directed toward the mission of attaining a ranking in the world's top 100 universities by 2020. UCD has identified the research-intensive environment as an area for development under the strategic initiative "Defining Educational Excellence". Predominantly qualitative research was undertaken to explore the understandings, perceptions and practice of research-teaching linkages (RTLs) amongst UCD faculty, across all colleges and academic grades.

Key Findings

1. UCD faculty consistently report an interplay between teaching and research which is two-way and reciprocally enhancing: research enhances teaching and teaching enhances research (Figure 1).
2. UCD faculty have a tacit understanding of research-teaching linkages, which is not directly informed by the pedagogic literature, but nonetheless reflects it. We found current practice to be driven by a core belief in actively linking research and teaching and in the advantages so conferred to UCD students.
3. There are multiple examples of research-teaching linkages in practice. Broadly, these map to a framework with three interacting phases: (1) teaching is enriched by research (2) developing the core skills/competencies required to undertake research (3) undertaking research (Figure 1).
4. Research-teaching linkages emerged as central to the core identity of UCD faculty. Faculty were internally motivated to make their academic identity as researchers explicit to students and to act as role models for students with an interest in careers in research. In parallel, they expressed a need and desire for a more formal academic approach to linking research and teaching.

Recommendations

1. UCD faculty have established many strong links between research and teaching, representing excellent and innovative practice in this domain. If cultivated, these links have the potential to be a key characteristic and distinguishing feature of a UCD education.
2. The practices of UCD Faculty in linking teaching and research have, in the main, developed at modular level and independently of specific institutional strategy, policy, incentive or support. Furthermore, UCD faculty have a highly developed conceptualisation of these linkages, which is underpinned by a core belief in their importance and rooted in their own identity as academics. UCD's future strategy for the development and enhancement of research-teaching linkages should be informed by and develop upon these intrinsic strengths.
3. Across disciplines, UCD faculty identified a number of factors which constrain the development of research-teaching linkages. We recommend institutional attention to:
 - a. Large class size
 - b. Length and structure of programmes: 4 year programmes and 10+ credit modules are cited as facilitators of students' participation in research.
 - c. Need for programme level approaches to maximise opportunities for UCD faculty to teach to their strengths (including on their research expertise) and for students to participate in the UCD framework of research-teaching linkages articulated in this report (Figure 1).
 - d. Need for resources and investment in the infrastructure necessary to support students in the undertaking of research (e.g. laboratory technical staff, purchase of consumables, etc).
4. Faculty perceive an institutional distinction between research and teaching roles which does not reflect their own sense of identity as both researchers and teachers. We recommend:
 - a. Formal institutional validation of, and support for, good practice in this domain.
 - b. Recognition and reward of excellence in linking teaching and research, including in academic promotions criteria.

Introduction

The viewpoint that research and teaching are inextricably linked has received much attention in the published literature. The development of research-teaching linkages has been a priority in the quality enhancement framework for Scottish universities and has been highlighted as one of the priority enhancement themes for the Higher Education Academy. Academic disciplines by convention have their own traditions, resulting in varying research approaches, methodologies and cultures, which ultimately determine the ways in which research-teaching linkages are shaped.

The conception of a modern research-intensive university rests, in part, on the claims of a close, even interdependent relationship between research and teaching. In a research-intensive university, research and teaching are closely interdependent, with teaching ideally being delivered by faculty active in the creation and advancement of knowledge. However, a number of factors conspire to undermine this relationship. Within a research-intensive university a growing emphasis on research output and impact, confounded by an imbalance between the rewards associated with research and those for teaching, has served to weaken the basis for the interdependence of the two.

Fundamental to the integration of research-teaching linkages and implicit in these issues are the perceptions of faculty of such linkages. Small studies by Jensen (1988) and Smeby (1998) have suggested that faculty show a preference for integrating teaching and research as opposed to focusing exclusively on one or the other. However, to date very little research exists at a university-wide level that explores faculty perceptions of the nature of the relationship between research and teaching. As such, there is a need to identify and explore faculty perceptions of such research-teaching linkages.

1.1. The International Context

The Boyer Commission: The National Commission on Educating Undergraduates in the Research University (hereafter referred to as the Boyer Commission), made up of eminent and creative thinkers from academia, government, and the arts, was formed in the 1990's, under the auspices of the Carnegie Foundation for the Advancement of Teaching. From its initiation, the Boyer Commission differed in two significant ways from other groups examining undergraduate education: (1) its exclusive emphasis was on research universities; (2) it endeavored to offer a vision, along with a delineation of the ways to achieve it. It was posited that this vision would serve as a guide for the transformation of education in research-intensive universities.

The commission acknowledged that research universities overwhelmingly contributed to the cultural, intellectual, economic and political leadership of the nation. However, at the same time the Commission noted the shortcomings of undergraduate education in research universities. They observed that by giving students "too little that will be of real value beyond a credential that will help them get their first jobs" (Boyer Commission, 1998), too often, research universities were "shortchanging" their students (Boyer Commission, 1998,). This derived from several factors, in particular the predominance of models of teaching and learning that fail to engage students, enable them to make connections across spheres of knowledge, or enhance their development of critical skills.

The commission clearly delineated the potential for research universities to offer a significantly different and enriched undergraduate experience based on their unique missions and assets: "research universities share a special set of characteristics and experience a range of common challenges in relation to their undergraduate students" (Boyer Commission, 1998). Among the most noteworthy characteristics of research universities are their multiple mission and vision statements; their diverse range of degree programs; a defining commitment to the creation of new knowledge integrally linked to the vision and activities of faculties and department; the presence of graduate students; and enormous diversity within the university community population. The commission recommended that research universities should endeavor to bring these elements to bear on the undergraduate education they provide and to create a model that draws on the mode of inquiry that is fundamental to their research and scholarly activities, which shape their training of graduate students.

The Boyer Commission report was driven by the principle that research universities are uniquely positioned to offer an undergraduate education that takes advantage of the immense resources of their research and graduate programs and that makes “research-based learning” (Boyer Commission, 1998) and exploitation of research-teaching linkages, the new education standard.

1.2. University College Dublin Context

The University College Dublin (UCD) Strategy (2015 – 2020) and Vision for 2020 outlines its commitment to providing an educational experience that meets international best practice. This is evident in the following paragraph taken from the Strategy 2015 – 2020 document: “through a holistic student-focussed and research-led education experience which has both breadth and depth, they (students) will be equipped with the knowledge, skills, experience and attitudes they need to flourish in present and future Irish and global societies”. This statement mirrors the assertions of the Boyer Commission regarding the capacity for utilizing research-based learning and research-teaching linkages as the new standard of education in undergraduate programs. Indeed one of UCD’s major strategic objectives, Defining Educational Excellence aligns closely to the Ten Ways to Change Undergraduate Education proposal outlined in the Boyer Commission document: Reinventing Undergraduate Education: A Blueprint for America’s Research Universities.

1.3. Rationale for Current Study

The University Senior Management Team has articulated Defining Educational Excellence as one of six strategic initiatives to be pursued by UCD in its drive to attain a position amongst the world’s top 100 universities by 2020. University-level leadership must be accompanied by fundamental support from faculty for the centrality of research-teaching linkages in undergraduate education. As such, there is a need to identify the understandings and perceptions of research-teaching linkages amongst UCD faculty.



Details of the Study

This study was undertaken as a joint collaboration between Professor Lorraine Brennan, Dr Tara Cusack, Dr Eamonn Delahunt and Dr Suzanne Donnelly. Following a competitive process they were appointed UCD Fellows in Teaching and Academic Development in 2014. Professor Brennan is a nutritionist, Dr Cusack and Dr Delahunt are physiotherapists and Dr Donnelly is a medical doctor. They were asked by the Fellowship Board to examine the perceptions of research-teaching linkages amongst UCD faculty. Ethical approval for this study was granted by the UCD Research Ethics Committee in November 2014 (LS-14-32-Delahunt).

2.1. Objective 1

This objective related to the exploration of what faculty understand by the term research-teaching linkages. An initial email was sent to all UCD Heads of Schools asking them to nominate up to 8 individuals, who were research active and who also contributed to undergraduate and/or post-graduate teaching. Nominated faculty were emailed and invited to participate in an online survey, with an option to volunteer to participate in a follow-up semi-structured interview. The survey asked respondents for demographic data together with an estimation of how research and teaching active they considered themselves to be. They were also asked to estimate how well they understood the concept of research-teaching linkages and how important they believed these linkages were in UCD.

2.2. Objectives 2 & 3

These objectives were focussed on investigating whether and/or how faculty use research to enhance their teaching, as well as identifying examples of good practice in terms of research-teaching linkages. To achieve these objectives a series of one-to-one semi-structured interviews were undertaken. The project team firstly stratified the participants to reflect two levels of academic grade [(1) College Lecturers/Senior Lecturers; (2) Associate Professors/Professors] and secondly ensured a balanced representation of male and female participants. Faculty were asked about their conceptualisation of research-teaching linkages and whether or how they used research to enhance their teaching while also being asked to identify areas of good practice relative to the linking of research and teaching. The semi-structured interview schedule was informed by the work of Lucas et al (2008). Interviews were audio-recorded and transcribed verbatim.

Quantitative data from the on-line surveys was aggregated by Survey Monkey (www.surveymonkey.com) before being analyzed. Thematic analysis was used to analyze the data from the semi-structured interview. This was undertaken manually without the assistance of any commercially available software. Thematic analysis is a method of identifying, analyzing and reporting patterns (themes) which occur within data (Braun & Clarke, 2006). It enables the organization, description, exploration and analysis of the data set.

In order to enhance the rigor of this qualitative research, we consulted with and applied the principles advocated by Morse (2015). Initially we became familiar with the data through a process of reading and re-reading the data set. Each member of the team read all interview transcripts independently, making initial observations regarding the data and proposing inductively derived codes. The codes addressed the research question and captured the perceptions, understandings and conceptualization of research-teaching linkages across the data. Following this an initial coding manual was developed which each author used to micro-code the interviews.

Results

3.1. Online Survey

Of the 38 Heads of School in UCD, 24 (64.8%) nominated 180 individuals as potential survey participants. One hundred and one faculty representing 24 schools across UCD completed the survey, with 77 individuals agreeing to participate in a one-to-one semi-structured interview. All 6 colleges were represented in the sample (Table 1).

We received survey responses from 14 Professors, 10 Associate Professors, 31 Senior Lecturers and 46 College Lecturers. In terms of profile, 54% of respondents were male, while 40% were aged in their 40's, and 30% in their 50's. In the region of 30% of respondents had a formal teaching and learning qualification. Seventy eight percent of respondents considered themselves very/extremely research active, while 91% consider themselves very/extremely active teachers. Only 52% of respondents felt they understood the concept of research-teaching linkages well or very well, however 77% believed research-teaching linkages were very or extremely important in UCD.

Table1. Survey responses by UCD College*

College	Percentage	Number of survey respondents (n=101)
UCD College of Agriculture, Food Science and Veterinary Medicine	7.92%	8
UCD College of Arts & Celtic Studies	13.86%	14
UCD College of Business & Law	10.89%	11
UCD College of Engineering & Architecture	10.89%	11
UCD College of Health Sciences	13.86%	14
UCD College of Human Sciences	17.82%	18
UCD College of Science	24.75%	25

*Since this study was completed there has been amalgamation of certain colleges to give a total of 6 colleges.

3.2. Semi-structured Interviews

In semester 2 of the academic term 2014/2015 a sample of 28 one-to-one semi-structured interviews were conducted across the university by an independent research assistant. Participants were purposively sampled using a stratified matrix to ensure representation across all grades and colleges and included 9 Professors/Associate Professors (6 men, 3 women) and 19 Senior Lecturers/Lecturers (8 men, 11 women) (Table 2).

Table 2. Survey Responses by School

School	Participation Green = Yes Red = No	Respondents from each School (n = 101)	Semi-structured Interviews (n = 28)
Agriculture & Food Science	●	8	4
Applied Social Science	●	0	0
Architecture	●	3	0
Art History & Cultural Policy	●	4	3
Biology & Environmental Science	●	7	2
Biomolecular & Biomedical Science	●	6	1
Biosystems Engineering	●	0	0
Business	●	7	3
Chemical & Bioprocess Engineering	●	3	0
Civil, Structural & Environmental Engineering	●	3	3
Chemistry & Chemical Biology	●	0	0
Classics	●	0	0
Computer Science & Informatics	●	6	0
Economics	●	0	0
Education	●	0	0
Electrical, Electronic & Communications Engineering	●	2	0
English, Drama & Film	●	0	0
Geography, Planning & Environmental Policy	●	0	0
Geological Sciences	●	4	1
History & Archives	●	3	1
Information & Library Studies	●	0	0
Irish, Celtic Studies, Irish Folklore & Linguistics	●	2	1
Languages & Literatures	●	4	1
Law	●	4	1
Mathematical Sciences	●	3	0
Mechanical & Materials Engineering	●	0	0
Medicine & Medical Science	●	3	2
Music	●	1	0
Nursing, Midwifery & Health Systems	●	6	1
Politics & International Relations	●	5	0
Physics	●	0	0
Psychology	●	7	3
Public Health, Physiotherapy & Population Science	●	4	1
School of Philosophy	●	1	0
Social Justice	●	3	0
Sociology	●	2	0
Veterinary Medicine	●	0	0

3.3. UCD Framework for Research-Teaching Linkages

The framework that emerged from analysis of the one-to-one semi-structured interviews portrays a UCD community of scholars actively engaged in multiple activities in which teaching/learning and research are explicitly linked. This endeavour is underpinned by a strong sense of academic identity (their own, that of their students/graduates and of the institution) and a tacit understanding of and strong belief in the concept of research-teaching linkages. This conceptualisation and commitment is translated into an organically driven influence of research on curricula in many disciplines. An unanticipated finding of this study was a widespread appreciation of the reciprocal positive influence of teaching on research: at individual, institutional and societal levels. This dimension of the concept is not adequately captured by the Healy and Jenkins model (2009) and is not widely reported in the literature. In the UCD faculty conceptualisation, research and teaching are viewed as reciprocally beneficial and explicitly linking them is considered to enhance the intellectual capital of the institution. The framework developed during this work is depicted in Figure 1.

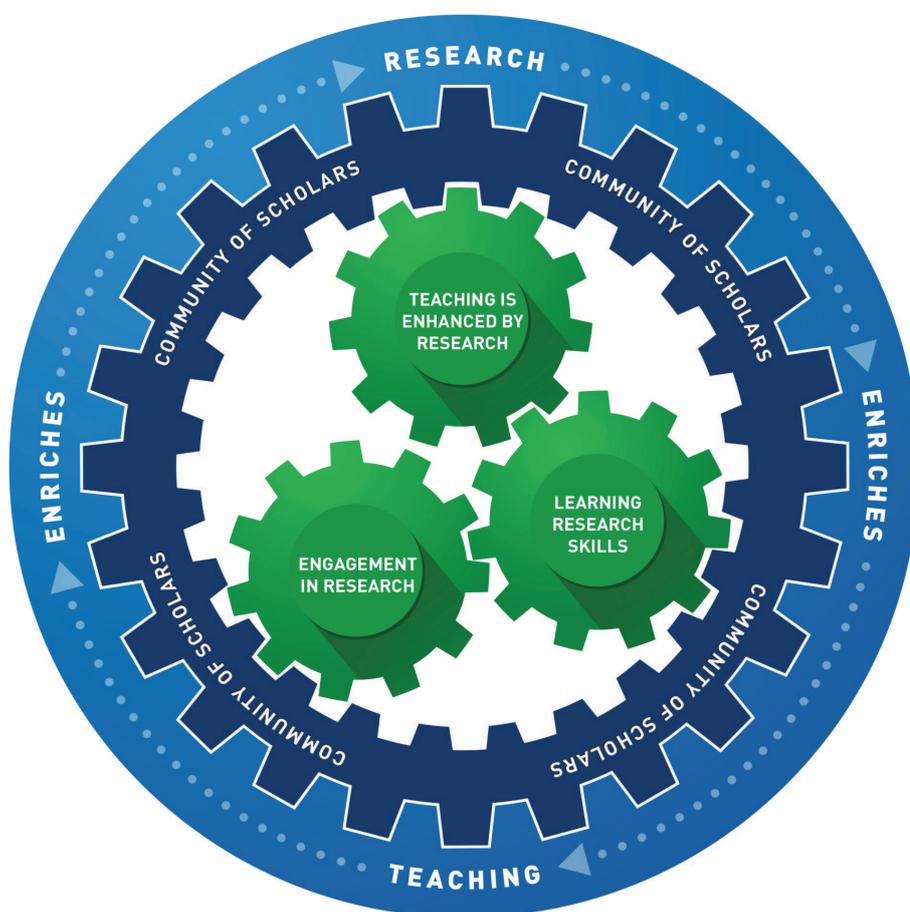


Figure 1. The UCD Research-teaching Linkages Framework.

The framework that emerged portrays a community of scholars actively engaged in multiple activities in which teaching/learning and research are explicitly linked.

3.4. Emerging Themes

3.4.1. Understanding and Conceptualisation

We found UCD faculty to have a tacit understanding of, and core belief in research-teaching linkages, which is not directly informed by the pedagogic literature base, but nonetheless reflects it. Notably, UCD faculty have a more developed conceptualisation of research-teaching linkages than that articulated by Healy and Jenkins (2009). UCD faculty report a two-way interplay between teaching and research, which is two-way and reciprocally enhancing: research enhances teaching and teaching enhances research (Figure 1).

Examples of supporting quotes:

So I find that the teaching does inform my research quite a bit as well. Not just the questions that students ask but also just the process of thinking about how to present something often informs them you know how you go about actually doing it as well, or think about it or other areas you might bring in. So I think it's a combination of linkages really. (Interview 5)

My understanding is very much two way... often when you are presented with a new course you have to read up, you know either within or outside your comfort zone and I find that reading and that preparation feeds back on my understanding of my own research and gives me ideas and equally it's incorporating current and past research into the teaching on a daily basis. (Interview 11)

If one teaches quite a lot over the years one can get students, questions from students that actually can help you to do research and some of my students have often asked me questions that at the time I tried to answer in class but that subsequently I found were not easy to answer and may have led me in a particular path to look up something and do research on it or maybe collect some data on it. (Interview 16)

Furthermore, UCD faculty believe that explicitly linking teaching and research is mutually beneficial to both students and staff and represents a true “community of scholars”.

I think actually that's another point is that the students like when you are teaching them something complex to bring in the fact that you know the whole community and you can say 'oh this is' you know ' [name 00:07:13] did this research and I was a post doc with him in Sheffield and I did this research in Chicago, this group are doing this'. So they actually realize that the field is small and once you become an expert you actually know the people as well and the stories of the people. (Interview 11)

Research-teaching linkages are seen as both the roots and shoots of our community of scholars and are described by some as “defining” our institution. However, faculty also perceive that there has been, at least historically, an institutional distinction between researchers and teachers, which favours faculty effort and activity in research.

I think a barrier has been that in the university the research and teaching have been looked at quite, have been kind of sectioned off a bit as I said. You are a good researcher or you are a good teacher but there has been very little of pushing them together and it is quite possible in UCD to close your door, lock the door and write lots and lots of papers and get promoted and never... never let that happen in teaching. (Interview 27)

One of the things that's constantly amazed me is around; if you devote your life to here teaching and being the best teacher in the world the chances of being promoted still seem to me to be slim. (Interview 2)

Faculty additionally recognise the importance of links between teaching and research on the external relationships of the university to industry and more broadly its place in society.

There is also, at national level, a strategic prioritization of that area of activity, industrial activity. So there is a demand for graduates and there is an interest from students. So they are all linked to each other. You can still have a masters programme in X because there is an industry demand for it. But you wouldn't be able to deliver it at level 9 or at the masters level without having research active lecturers and professors. (Interview 21)

3.4.2. Realisation of Research-Teaching Linkages

We found that while UCD faculty's understanding of research-teaching linkages is not directly informed by the existing pedagogic literature base, it is nonetheless translated into activities and initiatives which broadly map to the Healy and Jenkins (2009) framework. In the one-to-one semi-structured interviews, faculty described multiple examples of research-teaching linkages, many of which were self-initiated and which largely fall within the four quadrants of the Healy and Jenkins model (2009) viz research oriented; research informed; research led and research based. Furthermore, faculty described many activities which fall within the latter two "student-active" quadrants, generally considered to be the more educationally beneficial of the linkages. Specific examples are detailed in Tables 3a-c. It should be noted that these tables represent examples of good practice highlighted by faculty across UCD and may serve as examples for faculty in other disciplines. It is evident from the interviews that faculty universally use their own research and that of others to inform their teaching. Final year projects are highly valued by faculty and are a key feature of many four-year undergraduate degree programmes in UCD. Overall, while there was to a certain degree a mapping to the previously described quadrants in the Healy and Jenkins model (2009), we have depicted these as interacting activities under the headings of "teaching is enhanced by research", "learning research skills", and "engagement in research". Examples from each of these phases are given in Tables 3a, 3b and 3c.

Table 3a. Faculty Initiated Activities where Teaching is Enhanced by Research.

College (Discipline)	Activity	How Research-teaching Linkages are Facilitated
Agriculture, Food Science & Veterinary Medicine (Biology)	Flipped classroom	Students research the facts and the faculty member provides the context for the facts. Students are given references to papers which they read in advance for example: "where do red deer come from in Ireland?" With this they explore and examine a broad range of topics, such as how species occur.
Business & Law (Law)	Show and tell	Each week for ten weeks, students are required to individually post their reflections on a media piece online. At the end of the module these reflections make up each student's reflective journal.
Engineering & Architecture (Engineering)	Small group research experience for large groups	The students are broken up into groups of five, and they are set an assignment which is an example of inquiry-based learning. The assignment requires students to solve problems – the process they use to solve problems is based on the Stanford University Team-based Design Thinking Approach to problem solving.
Human Sciences (Psychology)	Researchers introduced in each lecture	Faculty introduce the work of key scientists/thinkers, "living thinkers" in the field. During the lecture students are provided with further resources, including hyperlinks to the work of these individuals.
Human Sciences (Psychology)	Research scenarios	The faculty member presents students with "in class" scenarios on research. The students explore data presented, and the conclusions drawn. They are encouraged to consider alternative ways of looking at the research issue. This experience is useful in terms of teaching students how to ask questions.
Science (Geology)	Case studies	The module is built around case studies from faculty published research. The students replicate the research.

Table 3b. Faculty Initiated Activities where Students Learn Research Skills.

College (Discipline)	Activity	How Research-teaching Linkages are Facilitated
Agriculture, Food Science & Veterinary Medicine (Agriculture, Food Science)	Scientific writing and review	Ten topics are presented to students. Each topic is associated with a set of supplied journal articles. Some papers are authored by UCD faculty. Students are required to source 3 additional articles. Students work with a peer to review and write about one particular topic.
Arts and Celtic Studies (History)	Research skills seminar	Students prepare for their dissertation by participating in a methods module which explores how research is conducted in history. They look at readings by scholars and examine how scholars go about research and how they deal with evidence.
Science (Biology)	Scientific enquiry	Students start with the results of a survey, a group of five students are allocated to a member of faculty, about 80 academics meet students once a week to conduct a literature review.
Science (Biology)	Scientific reading	Students are provided with a reading list – 10 papers, with a Question and Answer (Q&A) sheet relating specifically to each paper. The Q&A sheet guides students in their reading and assists development of an understanding of the papers.
Engineering & Architecture (Engineering)	Problem-based learning and Enquiry-based learning	Students are given problems to research, individually and in groups, and they are, by degrees and over time, given information to help them solve these problems.
Engineering & Architecture (Engineering)	Case studies	The faculty member addresses a topic covered in detail in class.
Engineering & Architecture (Engineering)	Key question: “What was your process of research?”	This key question has been shown to be very beneficial in encouraging students to think about research and to develop an understanding of, the work they are engaged in as research. This key question has brought about real development, evidenced in students’ reflective journals.



Table 3c. Faculty Initiated Activities where Students Engage in Research.

College (Discipline)	Activity	How Research-teaching Linkages are Facilitated
Agriculture, Food Science & Veterinary Medicine (Agriculture, Food Science)	Summer research activity	Students earn credit from participating in a faculty led summer research activity.
Arts and Celtic Studies (History)	Experimental archaeology	Students research and build structures and artefacts, they focus on material culture and through this process they get a sense of how things were in the past.
Business & Law (Business)	Project work	Students might be asked to replicate the methodology used in an already published paper – they gather data, and undertake summary analyses. Data is available on databases subscribed to in the Business School. Students are required to create virtual portfolios of assets.
Business & Law (Business)	Case studies	This is a real business case. Students pick a company and develop a relationship with the company, in order to be able to develop a research project around/with that company. The students analyse the organisation, and the industry.
Business & Law (Law)	Adopt a charity: basis for project.	Students adopt and offer specialist expertise to a charity of their choice. Their final year project is based on their experience with their charity.
Engineering & Architecture (Engineering)	Robo rugby	Students working in teams, build robots. This assignment is very much research based. It is a competitive process.
Engineering & Architecture (Engineering)	Engineering and D=design	Students work on designing a building, with input from people from industry. This is applied research. Students develop a lot of skills through this project work, including tendering skills.
Science (Science)	Funded bursaries for undergrads	These are competitively awarded research bursaries, and are based on students' grades. Students are funded to work in the lab, whereby they are embedded in the research team, and they get to do fieldwork.
Health Sciences (Medicine)	Research group meetings	Summer Student Research Awards, for research active students.

Faculty further described a progression of research-related activities undertaken by students in programmes; commencing with the development of core skills or competencies required for undertaking research and culminating in specific opportunities to undertake research themselves, usually in final-year projects.

They would see the methodology of research work and how research is undertaken in the practical sense and then they would also by way of their seminars, they would sort of see how literature review is done. So they would get the different skills, the different tools for research along the way leading up then until their final year, their final year project. (Interview 6)

There is a progression in a whole bunch of aspects; part of it has to do with skills development but part of it is that they become more, increasingly more engaged with doing research through the years. (Interview 5)

Additionally, faculty reported finding and creating opportunities to share the UCD culture of research, for example by using their own research as “cutting edge” or “state of the art” essential teaching material, or to illustrate the application of core principles in their discipline.

What is in the current textbooks is sometimes, sometimes out of date so the only way the students can become informed is by the lecturer being involved in research and innovation in that space I think. I think it's just very helpful to prepare students for what's happening in the future. (Interview 21)

Others referenced colleagues’ research to highlight the inter-connectedness of UCD research with innovation, policy and society.

I would always look for UCD authors so that the students really see UCD research, that they would know the lecturers and that this just connects the teaching and learning a bit more with lecturers and research in UCD. It usually is very well received because the students would know the lecturers within their programmes and they would say; ‘... had this big invention’ and so on. (Interview 8)

3.4.3. Tacit Understanding of Research-Teaching Linkages

While we found that faculty had translated a tacit understanding of research-teaching linkages into a multiplicity of activities mapping to the Healy & Jenkins (2009) framework, few were confident in discussing these in the language of the pedagogic scholarly literature.

... in the beginning of a series of lectures by providing at least one study per topic that I think is interesting or powerful and then dissecting it or teaching it in class in some way from different stand points. So if that counts as a research-teaching link then I do that. (Interview 16)

This is not a term that I have seen used in a wide sense. However, my research informs my teaching.

This term is not really clear to me.

I suspect I have relatively little understanding of the broader concepts involved

I think that the term may mean different things to different people so I am never sure what any one individual means when he/she uses the term

(Online survey, free text responses)

Furthermore, none referred to a literature base or demonstrated a knowledge of the literature in interviews. This lack of formal knowledge could not be described as a barrier to the initiation and development of research-teaching linkages in UCD, nor did it limit faculties’ conceptualisation of research-teaching linkages.

I teach courses that are specifically related to research and are based on ... my own idea of research and experience of research and also what other people have written and done ... But I suppose one of the problems I would have is what exactly does research-based teaching and learning mean? I think maybe people have different ideas about that. (Interview 12)

We note however, that almost all faculty interviewed expressed a desire for further education on both theoretical and practical aspects of research-teaching linkages. Specifically, they requested review, critique and evaluation of current activities (both their own and those of their programmes) by the institution and some instruction on evidence-based best practice.

A lot of what I have been saying is kind of my own interpretation of what I see as research-teaching linkages and I suppose, you know, my experience of the post-graduate certificate in teaching and learning would tell me that there is a lot of stuff in the whole teaching and learning literature that I wouldn't know much about and so I suspect that there is a whole range of research-teaching linkage theory or practice that I am unaware of and perhaps the school could do a series of workshops or seminars in terms of how, to explain that and give you know the examples. (Interview 9)

Internal motivation to build on current practice and to do more and better was a strong theme, however this was coupled with a plea for institutional validation and valorisation of research-teaching linkages activities to unlock further potential.

It would also be very nice if the university looked at the courses. ... Some kind of peer review from people who really know; from the teaching and learning based sort of side to say "well you seem to be doing this, but have you thought about this aspect" and you know that would be something the university could do. (Interview 5)

3.4.4. Deliberate Practice

While the pattern and sequencing of research-teaching linked activities described was reported across many schools and programmes, few faculty reported knowledge of any guiding policy on linking teaching and research at the level of the programme, school or institution, or of institutional supports for good practice. Rather, their current practice is largely based on a core belief in actively linking research and teaching in programmes and the advantage so conferred to UCD students.

What is in the current textbooks is sometimes, sometimes out of date so the only way the students can become informed is by the lecturer being involved in research and innovation in that space I think. I think it's just very helpful to prepare students for what's happening in the future. (Interview 21)

In many interviews, research-teaching linkages were described as having grown organically; initiated through the personal motivation of academics to purposefully link their dual activities and to make these links explicit to their students, thus creating a community of scholars.

And then in fourth year, well by then they are embedded in my research group and I would invite them, I have a lab meeting every week. They are invited. The undergrads are invited to those lab meetings. They don't have to come but they can attend as many or as few as they like and we prepare them for their undergraduate presentation so they always do a mock presentation in front of my group first where we give them a tough time but it's a nice audience and prepares them for questions for when they go ahead and present in front of the whole school. (Interview 11)

On the one hand, faculty reported that maintaining established research-teaching linkages is challenging (see Table 4), yet they simultaneously enthusiastically described untapped opportunities which could be developed if support and resources were directed to these. UCD faculty at all levels have sought out and engaged in research-teaching linkages which do not demand extra resource at the level of individual modules or even lectures.

Right there in the class I said: "I want you to design an experiment where you'd actually do a better job than these authors", and of course they hadn't a clue. So, and it was great, they really enjoyed it. I made them work in teams. I made them design an experiment. They had to present it up to the class and I let them completely get it all wrong and then very gently corrected them and they went back to the drawing board and they basically kept coming back and by the end of the class each group had a realistic experiment where they could actually test the hypotheses posed in the paper but what it made them realize is it was really difficult and it gave them a different insight into actually the work that had been done and they were a lot less dismissive when they realized how difficult it was to design a really good experiment. (Interview 11)

Many faculty have deliberately "designed in" multiple opportunities for students to encounter and experience research in their learning. Some report having reluctantly had to abandon these due to lack of resources or an increase in student numbers.

3.4.5. Identity and Academic Purpose

A core belief in the intrinsic link between research and teaching is central to faculties' conceptualization of identity in UCD: both their own identity as UCD faculty and that of their students and graduates. In turn, this was a strong influence on faculties' motivation to purposefully link teaching and research.

So there might be a particular topic and then to say "well this is the research that is going on in this area", and to show the students, I am thinking particularly of the undergraduates, you know the relevance of research, the place of research in the university's life and to show them that there is more to being in the university than being at class. (Interview 6)

So they are getting a sense that we are not just lecturers; I am not just a lecturer I am also a researcher. (Interview 11)

My expertise is ... and my aim in doing that is to hopefully one day inspire one of them to say "oh I actually find this really interesting and I want to go on and do more". (Interview 5)

Specific graduate identity- or the lack thereof- was described by many faculty to influence student attitudes to and perceived engagement with research in their curricula. Many faculty were motivated to make their academic identity as researchers explicit to students and to act as potential role models for future research careers, whilst accepting that only a minority of students would ultimately choose this path.

Even though we know we are doing broad teaching for a lot of people who won't go into our discipline there are a few people who will and we need those people. So I think we need to target them as well so. That's an important part. ... I believe that whatever they end up doing in their life they should always have the potential to have the option of a research career in ... (Interview 5)

Others described research as fundamental to future graduate identity and in-programme research opportunities as positively influencing student engagement with their core discipline – a vehicle for innovation, authenticity and employability.

In third year I am in the lab with the students and it's small group teaching and they are being exposed; the demonstrators in my labs are my PhD students and I also bring in a post-doc into each lab so they are learning that there is a research team and I usually in the labs will say "oh you know this is ... and you are going to be looking at ...". We will actually use specimens that they have collected in the field. So we give examples of, we use demonstration material from our research so the students will have their task but there will also be material that has been collected in the field as part of a big research project so that they can see "here is a real world example". (Interview 11)

I don't know if it's just that the audience here is ... students but I think it's important to help with the engagement that students are made aware of how I suppose fundamental research is translated into a commercial reality. Bearing in mind that not all fundamental research ends up in a commercial context but some of it does and I think that can be part of the story in terms of greater student engagement. We don't set out to do much of it at the moment but our students who do internships do get an opportunity to work

in the spin out companies that we have in the school. We have nearly 10% of the students do that so it's important. (Interview 21)

For courses associated with a very specific graduate identity or for which there is external accreditation of programmes by a professional or regulatory body, this could be both a constraining and facilitating influence on research-teaching linkages in curricula.

So let's say if EU legislation is changing on the policy in X ... then we will have to change what we teach on that ... it's not I think directly influenced by our research because the actual driver is industry developments or skills needs or changes in policy. Now all of these changes of course will also mean that we have to do some research on that usually ... but research itself is never the driver of the actual teaching content. (Interview 8)

In terms of the barriers I think for us and I would say it's probably the same for a lot of professional courses – there is always the outside pressure ... There are certain things when they step out of here they have to know and it doesn't matter what else, that has to be done and it's just a lot to get through at times. I think that's probably the biggest barrier to giving students that little bit more independence and time to think. (Interview 27)

I suppose the constraints on ... X being an accredited programme. It's not a barrier because there is a requirement to have research-teaching linkages in there. But there is always a time barrier because you have to cover a lot of material in the four stages of the programme that might not give priority to research-teaching linkages especially in stage one and stage two ... (Interview 21)

Notably, senior faculty report that even in this circumstance, a school's aspiration that its graduates be tomorrow's effective practitioners, leaders and innovators requires a strong research foundation.

In terms of what our horizons are for our students we would expect them to be decision makers, leaders within their profession. So we would expect them to be able to interpret, you know, state of the art research and how that influences the businesses that they are involved in or their careers. So in that sense they have to be linked. So all of our teaching or the college teaching is directly influenced by up to date research. (Interview 4)

Faculty also report that traditional knowledge outcomes of programmes may have to make way for research activities and describe the impact of this on the broader perceptions of the identity of a discipline and the potential tensions to which this may give rise.

We have evolved from a place where biology essentially meant looking at every possible different type of animal and plant to now far more looking at the way animals and plants operate and not necessarily knowing every single animal or plant. And that was, that continues to be a sort of a tensionbecause for example, you go to the seashore and a student who is doing very well in your class doesn't know what a starfish is and he is in the zoology programme. (Interview 2)

There is ... I would feel a certain amount of content that needs to be covered and so the barrier then becomes, do I sacrifice some of the content so that I can teach certain basic research skills. (Interview 9)

Finally, we report a widely held belief that the linked pursuits of teaching and research are the core identity of this institution, described by one interviewee as *"the modern expression of a university scholar"*.

3.4.6. Influencing Factors on the Initiation, Sustainability and Development of Research-Teaching Linkages

Faculty across different disciplines reported similar influencing factors on the success of linking teaching and research in UCD. The most consistently reported factors across all disciplines were feasibility factors outside academic faculties sphere of influence: the structure and duration of programmes, and the resources required to support this endeavour, including staffing. Influencing factors at the macro (institutional) meso (school/ programme) and micro (faculty/student) level are summarised in Table 4, alongside the parallel opportunities that each presents for the promotion of research-teaching linkages in UCD.

Table 4. Factors Reported by Faculty to Influence Links Between Research and Teaching in UCD (2015)

Level of Influence	Positively Influencing Factor	Negatively Influencing Factor	Opportunity for Development of Research-Teaching Linkages	Sample Quote
Faculty	Intrinsic belief in and commitment to research-teaching linkages as core to academic identity and mission in UCD	Mismatch between faculties area of research and area of teaching reduces research-teaching linkages opportunities	Faculty recruitment & deployment strategy that purposefully links teaching and research	<p><i>What I can see is that new staff are only selected on the basis of research potential so I'm not sure that they will actually do a lot of teaching because they are just not interested... but you know they are certainly up to date with their research but it's maybe not always the kind of research we actually need to teach. (Interview 8)</i></p> <p><i>With regard to my own research there is sort of a disjoint between what my research interests are and what I am teaching. (Interview 14)</i></p> <p><i>But I think a key issue; the only thing I would say is that you need to link the area in which somebody is doing their teaching to the area in which they are carrying out their research. It sounds obvious but it's not always the case. (Interview 13)</i></p>
				<p><i>I don't know an awful lot about it in terms of enhancing teaching. I mean I would be interested in going to a workshop say on ways of thinking ... of how to get your research to influence your students because if we are going to be a serious research institution we have to ... I would be open to help from the university with that. (Interview 14)</i></p> <p><i>I think that we actually make a lot of effort to try to do these various ... ways of bringing research into it for them. (Interview 8)</i></p>
				<p><i>In our school every single member of staff has a fourth year module which is research. It's a module in their specialist research area ... they will teach first, second, third but everybody has their specialist module which is usually the one they are the expert in. So they are all research led. (Interview 11)</i></p> <p><i>We have expanded the module to include areas specifically related to the research expertise that I have. To give them an example of a state of the art area that's actually under research, under investigation at the moment and maybe isn't as dogmatic as some of the stuff that's in the text books. (Interview 13)</i></p>
	Faculty have successfully self-initiated many research teaching linkages in their courses	Lack of awareness of activities in other modules/ courses/ schools	Sharing models and examples of best practice in research-teaching linkages across campus	
	Faculty enthusiasm to utilise their research expertise in their teaching	Limited opportunities for researchers to teach to their expertise	Provide explicit opportunities for faculty to incorporate their research expertise in curricula Empower faculty to use their own research in teaching, including to teach general principles	

Level of Influence	Positively Influencing Factor	Negatively Influencing Factor	Opportunity for Development of Research-Teaching Linkages	Sample Quote
	Faculty have intrinsic motivation to do "more and better"	Lack of systems to encourage, capture & reward good practice including in promotions criteria Research generates better rewards than teaching	Promotion criteria should reflect institutional strategy to develop good practice in research-teaching linkages	<i>One of the things that's constantly amazed me is if you devote your life here to teaching and being the best teacher in the world the chances of being promoted still seem to me to be slim. (Interview 2)</i> <i>Younger staff are under huge pressure to develop very strong research profiles and if they are doing that then it's very hard for them to additionally and deliberately blend that into their teaching, other than of course using their research to inform some of their teaching. (Interview 1)</i>
Students	Self-direction in learning Motivation for in-depth study of area of interest	Research skills for learners not "front-loaded" or taught as common stem	Research skills training could be delivered early in degree courses Deliver research skills training in common core module	<i>They find it very very challenging because they have to do quite a bit of thinking for themselves and some of them are unfortunately shy or hesitant in asking for help. So sometimes we have to push people to keep in contact because it's very easy in second semester and final year to just get lost, and occasionally we would have one or two students who goes to ground and we can't get them back out of it. But that is very very rare. (Interview 14)</i> <i>The thesis project is a bit difficult sometimes because you know students lack the basic skills because they actually have no modules beforehand that would particularly focus on research skills. (Interview 8)</i>
	Faculty perceive that students enjoy research	Faculty perceive that students do not see relevance of research to future career/employability	Make research relevant to learners: e.g. external links with industry to support student engagement in research related to career interest	<i>They find it is the most difficult part of their studies here but it's the most rewarding and we also encourage them to pick an area through their research that they particularly are interested in building a career out of and again it adds to employability. (Interview 4)</i>
		Student numbers & class sizes too large Research opportunities for students often by competition	Faculty development in delivering research-teaching linkages to engage large classes Resource opportunities for all students	<i>To develop research skills in an undergrad population you really need to be ... working with a small group and our class sizes are just monstrous so it's really difficult to get anything going. (Interview 1)</i>

Level of Influence	Positively Influencing Factor	Negatively Influencing Factor	Opportunity for Development of Research-Teaching Linkages	Sample Quote
Programme Design & Structure	4-year degrees	3-year degrees	Consider increase in degree length to facilitate opportunities to engage in research	<i>I mean in science they solve it by having four year degrees. That's pretty clear. We don't have that option here in arts. So, and we could use more of the year long, but it seems to me that we would have to explain you know why we would want to have a year-long course in environmental archaeology, you know as opposed to just a semester. So I think that's a time/money pressure that really impinges on how we can teach research. (Interview 5)</i>
	10 credit modules	5 credit modules	Approve 10 credit modules in which students can do research	<i>I would say, you know, the continuation of these 10 credit modules is dependent on approval by the University. I would hope that these were supported and ... I know that other schools are interested in doing it. I am very strongly encouraging that- I think it really does allow for research to be advanced and for students to be able to do that. (Interview 12)</i> <i>Come back to the 5 credit 10 credit thing. That's one area in which being allowed to do 10 credit modules has a huge impact. (Interview 13)</i>
	Examples of cross-school research skills modules	Core degree content which must be delivered	Develop cross-disciplinary research skills modules	<i>It's an interesting module because it's core for about ten degree programmes in X and also in Y so it's a big class. I give them a choice of ten topics- they choose. Each of those have three ... set articles with it so they have to read those and then they have to find three additional ones on one aspect of the topics and so as I just said the idea is that they have an actual topic they are interested in because of their study... Then they do all the exercises like a peer review or a presentation ... you know ... data base search and so on with this problem. So this I think is a nice way of doing it and it works well. (Interview 8)</i>
Institution	Many examples of good practice at level of module (influenced by coordinator)	Coordination or oversight of research-teaching linkages at programme level reported infrequently	Programmatic approach to RTLs, link to institutional curriculum review process	<i>I think it's a collaborative thing; it's not just to do with me wanting to do it. It's to do with the school and our fitting the strategy of the school. (Interview 12)</i> <i>Well the school itself I think is doing okay. I mean if you asked me before you know if the school actually has a plan and so on I'm not sure there is actually a plan but usually if you want change and you want to let's say more research in from then I think you need to basically decide you would do this in the school and then everybody has to do it and not ... you know ... that individuals who go off and do it on their own but I'm not aware of initiatives in the school. (Interview 8)</i>

Level of Influence	Positively Influencing Factor	Negatively Influencing Factor	Opportunity for Development of Research-Teaching Linkages	Sample Quote
	Professional/ accredited degrees may mandate research in core competencies	Professional/ accredited degrees may limit research-teaching linkages due to need to deliver core material		<i>When we design a curriculum the main driver is still what does the professional body... it's still very much, "well they have a list of what they want, where can we say we have covered that in each module"? You know so when they come in that we can present the evidence to them of "we achieved learning objective 1 in that module, that module and that module". Rather than trying to be driven by research. (Interview 27)</i>
	New facilities & resources to support student research	Reduced support for infrastructure that underpins research-teaching linkages (e.g. laboratories, technical staff, space)	Identification of and investment in key resources for maintenance and development of RTLs	<i>Outside our control is the financial issue actually because the most authentic research experience that they get is the fourth year project which ideally should for every student be a lab based project.....and one of the biggest difficulties we face as a discipline or at a school level is the cost of these projects. From a consumables point of view all the chemicals and so on that they use in the lab, that's very expensive. So that money has got to come from somewhere and it's also very expensive in terms of manpower because the students need close supervision. Interview 1</i> <i>We have run into a massive resource problem. It's not too bad this year because student numbers are lower but next year is going to be catastrophic....in our programme students would undertake a laboratory or field research project in their final year so they get the real cutting edge of research that we are doing at the moment Interview 14</i>
	UCD Teaching & Learning engaged with development of research-teaching linkages	No programmatic level institutional review of research-teaching linkages	Deliver programmatic level institutional review of research-teaching linkages Involve UCD Teaching & Learning	<i>It would also be very nice if the university looked at the courses. Maybe I guess they can't do it every year at every course but if they sort of said "this year I am going to look at the school of archaeology courses and just see how they are dealing with this issue". I think that would be really useful because it could highlight like the things we already know but also you know that there are things maybe we are not doing. (Interview 5)</i>
	2014-15 T&L Fellows' Project & outputs thereof	Perceived lack of educational support & initiatives to encourage good practice	Workshops, web based & print resources based on exemplars of good practice, including outputs of Fellows' project	<i>I am intrigued by the concept of my fellow academics across the university and their approach to research in teaching. (Interview 10)</i> <i>So if there was some sort of a discussion paper about what research teaching linkages means and a compendium of best practice examples and that would be really useful because it would give everybody ... it would share all of those ideas. (Interview 1)</i>

Level of Influence	Positively Influencing Factor	Negatively Influencing Factor	Opportunity for Development of Research-Teaching Linkages	Sample Quote
				<i>To be honest I am hoping that the outcomes of this particular project will help inform. It's something I will be reading with interest whenever the project is concluded. (Interview 21)</i>
	Strategic importance of research-teaching linkages articulated by President	Faculty unaware of strategy or policy on research-teaching linkages	Raise awareness & develop institution, college and school-specific policies	<i>I am not aware it's even on the agenda as something in our school that we should be practicing research teaching and linkages or not. Until this email came and asked me about research teaching and linkages I had never heard of it mentioned at UCD (Interview 9)</i>

Table 5 Faculty Reported Benefits of Linking Research and Teaching

Benefits to Faculty	Benefits to Students
Delivery of current and contemporaneous material if research and teaching are aligned	Exposure to research thinking
Creates opportunities for advanced mentoring of graduate research students by giving them the opportunity to teach	Apprenticeship in research methodology and structure
Development of industry links	Development of skills in critical appraisal and review of literature
Development of new ideas for research	Development of oral presentation skills
Enhances confidence in teaching if there is alignment between research and teaching	Development of written presentations skills
Allows for the identification of potential graduate research students	Learning current best practices
Delivery of expertise beyond the traditional textbook	Development of problem solving skills
Using teaching as a research source	Development of communication skills
Development of industry links	Development of teamwork skills
Opportunities for life-long collaboration	Critical thinking
	Development of desirable graduate attributes
	Enhances employability
	Experimental design and delivery
	Engagement with industry

Recommendations

Numerous strong linkages between research and teaching have been established by UCD faculty, representing excellent and innovative practice in this domain. If cultivated, this educational experience has the potential to be a key characteristic and distinguishing feature of a UCD education.

Schools should ensure that there is an alignment between research expertise and teaching. Faculty should have the opportunity to teach in the area in which they are conducting their research.

A system of rewards for innovative solutions to addressing research-teaching linkages would stimulate and motivate engagement in terms of improving research-teaching linkages.

Opportunities could be provided to enable individuals to showcase their research-teaching linkage practices; this could in turn encourage other faculty to consider engaging in these activities.

UCD practices in linking research and teaching have, in the main, developed at modular level and independently of specific institutional strategy, policy, incentive or support. Furthermore, faculty have a highly developed conceptualisation of these linkages which is underpinned by a core belief in their importance and rooted in their own identity as academics. Institutional policy on research-teaching linkages should be informed by and leverage these intrinsic strengths.

Research-teaching linkages should be developed in the early stage of programmes.

This framework and report could serve as a guide to the way in which research-teaching linkages could be threaded through UCD programmes.

Across disciplines, faculty identified the following factors outside their control which constrain the development of research-teaching linkages. We recommend institutional attention to:

- Large class size
Faculty would benefit from receiving specific training in teaching approaches which would enable the delivery of research-teaching linkages in large group settings. Examples would include: flipped classrooms, problem based learning for large groups, enabling students to conduct reviews of scientific papers, introducing students to key researchers in a field etc.
- Length and structure of programmes
4 year programmes and 10+ credit modules are cited as facilitators of students' participation in research 10 credit modules enabling research-teaching linkages would become commonplace.

Research modules which enable students to undertake their own research could take place over 2 semesters.
- Need for programme level approaches to maximise opportunities for staff to teach to their strengths (including on their research expertise) and for students to participate in the UCD framework of research-teaching linkages articulated in this report.
The UCD framework for research-teaching linkages presented in this report could be used as a tool to map research-teaching linkages across programmes and in so doing identify "the gaps" and how these might be addressed.

- Need for resources and investment in the infrastructure necessary to support students in the undertaking of research (e.g. laboratory technical staff, purchase of consumables, etc).

Faculty perceive an institutional distinction between research and teaching roles which does not reflect their own sense of identity as both researchers and teachers. We recommend:

- Formal institutional validation of, and support for, good practice in this domain.
- Recognition and reward of excellence in linking teaching and research, including in faculty promotions criteria.

6

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