Editors’ introduction

Developing the higher education curriculum

Research-based education in practice

Brent Carnell and Dilly Fung

Introduction

Illustrating the Connected Curriculum approach, a distinctive research-based education model for developing programmes of study in higher education (Fung 2017; Fung and Carnell 2017), this book showcases a range of innovative practices from across the higher education sector. The following chapters shine a light on different disciplinary and institutional contexts, offering insights into ways of enriching students’ learning experiences. Together, the practical case studies point the way towards building communities of scholarly enquiry that challenge old divisions between research and teaching, between researcher, teacher and learner, and between higher education institutions and society.

Higher education scholar Dilly Fung (2017) presents the Connected Curriculum on one level as a simple visual framework (Figure 0.1), designed to act as a stimulus for constructive dialogue about how degree programmes – both undergraduate and postgraduate – are designed, and about how students learn.

The framework comprises a core educational principle – that students should learn predominantly through research and critical enquiry, rather than by passively receiving accepted knowledge – and six related dimensions of practice, to which we will return below. Importantly, however, this framing also speaks to fundamental departmental and
institutional values and to the cultures in which those programmes are situated. The underpinning ‘connections’ approach reflects a values-based, philosophical commitment to the advancement of global human knowledge, understanding and wellbeing. Through critical dialogue and creative, collaborative practice, Fung argues, we can take up the challenge of breaking down ‘longstanding divisions between research and education’, in order to ‘build stronger bridges between research, education, professional practice and society’ (Fung 2017: 156).

The six dimensions of the framework (Figure 0.1) include connecting students directly with researchers, encouraging students to make connections between different disciplinary perspectives, and empowering them to engage external audiences with the findings of their enquiry. The core principle, that of students learning actively through research and enquiry, reflects a commitment to ‘research-based’ education, rather than to curricula which are simply informed by or about research.

Fig. 0.1 The Connected Curriculum framework
The term ‘research-based’ is drawn from work by Healey and Jenkins (2009), whose characterisation of four different ways of engaging students with research has been influential in the literature in this field. Healey and Jenkins distinguish between ‘research-led’ programmes, in which students learn about current research in the discipline; ‘research-oriented’, whereby students develop research skills and techniques; ‘research-tutored’, where students engage in research discussions, and finally ‘research-based’ programmes, in which students themselves undertake research and enquiry-based activities (Healey and Jenkins 2009: 6). The four areas of practice are not mutually exclusive, of course – in fact, all are valuable – but the research-based approach emphasises the importance for students’ development of active, engaged, enquiry-based learning. It gives agency to students (Levy and Petrulis 2012), positioning them individually and collectively as both critics and creative producers. It also enables them to develop a wide range of research-related insights, qualities and skills and, in doing so, move towards understanding the edges of established knowledge (Fung 2017; Fung, Besters-Dilger and van der Vaart 2017).

It is far from simple to establish a simple causal link between research-based approaches to teaching and ‘effective’ student learning (Elken and Wollscheid 2016). This is because of the huge number of variables at play when such approaches are studied. These variables are found, for example, in student demographics; in students’ prior learning experiences; in disciplinary and departmental contexts and cultures; in the communication styles and assumptions of those who are teaching or facilitating learning; and, very importantly, in the design of the research-based activities in relation to the types of desired learning outcomes. However, a growing body of studies across the disciplines is showing how valuable and effective research-based approaches can be (Barnett 2005; Blair 2015; Brew 2006; Chang 2005; Kreber 2009; Healey and Jenkins 2009; Walkington 2015). Studies by Nobel prize-winning physicist Carl Wieman and his colleagues offer some very promising evidence that active, enquiry-based approaches lead to highly effective learning (see, for example, Wieman and Gilbert 2015). Other studies highlight the importance of structuring the parameters of students’ enquiry well, so that while they are encouraged to critique established knowledge and develop new, creative approaches, they are also supported by peers, for example through collaborative group work, and by engaging in structured dialogue with more experienced scholars (Blessinger and Carfora 2014; Levy and Petrulis 2012; Spronken-Smith and Walker 2010; Wood...
Active enquiry can be challenging for students at first – being a passive listener in a lecture theatre may seem like an easier option – but where students are gradually exposed to greater levels of freedom and challenge, the benefits to their levels of understanding, confidence and skills are considerable.

Surrounding this core educational principle are the six related dimensions of practice (Figure 0.1). In her open access monograph, Fung (2017) explores each dimension in detail, providing examples of specific learning activities and practical curriculum design possibilities that exemplify each one. Here we will highlight two of the most stretching dimensions: the second and fifth.

The second dimension of the Connected Curriculum is that of building a connected ‘throughline’ of enquiry-based activity into each programme of study. This provides a structure for gradually building research skills that are vital for both academic study and professional life. It also empowers students to take ownership of their learning and their developing personal and professional identity, and articulate their own, overall learning story. Practical approaches in relation to this dimension include designing into each level of study a ‘Connections’ module, which explicitly challenges students to make connections between apparently diverse elements of their degree programme, and introducing a programme-wide Showcase Portfolio, which enables students to revisit, select, develop, curate and comment analytically on the body of work they have produced (Fung 2017: Chapter 4).

The fifth dimension is also of key importance. This focuses on the production of outputs: assessments directed at an audience. Here, university educators are challenged to include elements of student assessment that are explicitly addressed to, and may even be developed in partnership with, audiences beyond the university – individuals or groups who already have an interest in the topic, or who can benefit from becoming engaged with it. Such an approach helps students to develop a wide range of communication forms and skills, including vital digital practices. Students can be assessed, for example, through making film documentaries or websites, writing articles for specific journals, presenting their work at a student conference, or running an event which engages the public (Fung 2017: Chapter 7).

We revisit all six dimensions now by reproducing a number of questions for departments (researchers, educators, professional staff and students) and their students to discuss, in relation to each one (Table 0.1).
<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Key questions for departments and programme teams</th>
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| **Core principle** | 1. Are students encountering specific questions addressed by researchers and learning to articulate their own research questions, at every level of study?  
2. Can we adjust our teaching methods, student assessments and other aspects of departmental practice to prioritise engaging all students actively in research and critical enquiry? |
| **Students learn through research and enquiry** | 3. Do students have regular opportunities to learn about the institution's research, and other current research relevant to their studies?  
4. Are students meeting with researchers and engaging with their work?  
5. Are students exploring the intellectual, policy-related, practical and ethical challenges associated with current research, and recognising their relevance to professional life more widely? |
| **Dimension 1** | 6. Is there a well designed core sequence of modules, units and/or learning activities through which students steadily build their research skills and understandings, and is this explicit to students?  
7. Are students explicitly challenged to make intellectual connections between different elements of their programme?  
8. Can students have some flexibility and even take risks with their research-related activities, for example by working towards a Showcase Portfolio for which they can curate their best work? |
| **A throughline of research activity is built into each programme** | 9. Is the programme of study structured so that students need to step outside their home discipline(s) and see through at least one other disciplinary lens?  
10. Are students required to make explicit connections between disciplinary perspectives, for example by collaborating with students of other disciplines to analyse evidence and issues?  
11. Through making interdisciplinary connections, are students challenged to address complex global challenges? |
| **Dimension 3** | (Continued) |
Table 0.1 (Contd)

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Key questions for departments and programme teams</th>
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<tbody>
<tr>
<td>Dimension 4</td>
<td>Students connect academic learning with workplace learning</td>
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<tr>
<td>12.</td>
<td>Are all students on the programme(s) able to analyse the ways in which their academic learning is relevant to the world of work?</td>
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<tr>
<td>13.</td>
<td>Do students have explicit opportunities to prepare for the workplace, for example through meeting alumni, shadowing, and work placements, and where appropriate through critiquing the notions of work and professionalism in society?</td>
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<td>14.</td>
<td>Can students articulate effectively the skills and knowledge they have developed through their research-related activities and through their wider studies and experiences, and showcase these to future employers?</td>
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<td>Dimension 5</td>
<td>Students learn to produce outputs: assessments directed at an audience</td>
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<td>15.</td>
<td>Are some student assessments outward-facing, directed at an audience, thereby enabling them to connect with local and/or wider communities (whether online or face-to-face)?</td>
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<td>16.</td>
<td>Are student assessments across the programme suitably varied, enabling them to develop a range of skills including expertise in digital practices and communications?</td>
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<td>17.</td>
<td>Are students required to revisit and use feedback on their tasks, both formative and summative, in order to improve their work?</td>
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<td>Dimension 6</td>
<td>Students connect with each other, across phases and with alumni</td>
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<td>18.</td>
<td>Do students have frequent opportunities to meet and participate in collaborative enquiry with one another in diverse groups?</td>
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<td>19.</td>
<td>Are they building connections with students in other year groups, for example through events or mentoring schemes?</td>
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<tr>
<td>20.</td>
<td>Can students meet and learn from diverse alumni, and build a strong sense of belonging to an inclusive research and learning community?</td>
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Adapted from Fung 2017: 146.

We are keen to emphasise here that these questions are designed to provoke wide-ranging discussion. The Connected Curriculum framework (Figure 0.1) and these associated questions are not designed to restrict thinking about curriculum and about institutional cultures. Instead, they are a stimulus for building a broad spectrum of dynamic
new critiques and practices that suit the relevant disciplinary and institutional cultures. The Connected Curriculum framework was integrated into UCL (University College London) institutional strategy (UCLa 2017), and the range and depth of discussions and curriculum design innovations resulting from engaging with it has proved very promising (Fung 2017: Chapter 9).

The chapters that follow, from UCL authors as well as contributors from many other institutions, present a variety of practices that highlight the diversity of approaches implied by Connected Curriculum framing. These include two very important, related areas of values-based activity:

1. Including students as partners and co-creators in their learning and research communities, so that they are empowered to challenge the status quo and bring about creative, evidence-based changes in their institution’s practices (see, for example, Bovill, Cook-Sather and Felton 2011; Dunne and Zandstra 2011; Healey, Flint and Harrington 2014); and
2. Challenging Eurocentric, male-dominated curriculum content, and building curricula that represent fairly the work of marginalised scholars (UCLb 2017).

The Connected Curriculum approach is thus about more than curriculum design: it opens windows onto deeper themes, including the nature of knowledge and its contribution to society, and is a catalyst for exploration of values and purposes. We argue that developing and enhancing student education in the higher education sector is not just a question of improving learning design, as important as this is. It is about critically and constructively addressing deeper questions about what we mean by ‘good’ education in a challenging era. What are universities trying to achieve, for whom, and according to whose values? Can institutions keep a strong focus on values, promoting evidence-based critical enquiry at a time when the mass media present a kaleidoscope of facts, ‘alternative facts’, news and ‘fake news’?

The values underpinning the Connected Curriculum include a principled commitment to the unity of teaching and research; a commitment to building democratic human relations and inclusive communities; and a commitment to focusing its activity, both research and education, on the advancement of the global common good (UNESCO 2015). The associated practices are varied, innovative and creative – as evidenced by the following chapters.
The book’s chapters

The 15 chapters in this collection are contributions from a diverse range of authors offering research-based education interventions to curricula. Some chapters are firmly based in a subject-discipline – including art history, biochemistry, education, engineering, fashion and design, healthcare and veterinary sciences. While there are inevitable oversights in a compact edited volume, the collection goes some way (though could go further) to reach across geopolitical regions, with contributions from Australia, Canada, China, England, Scotland and South Africa.

In Chapter 1, Corony Edwards and Mike McLinden focus on ways of developing student links between research and teaching, in a range of disciplines, so that their learning journey is rich and engaging. They argue that linking research and teaching enables programmes to attain ‘pedagogic resonance’ between course design, learning activities and disciplinary approaches. Their model of pedagogic resonance aims to ensure that there is alignment between students’ experience of a given learning design and learning experience within a specific discipline. Not only do the case studies show the varied ways research-informed learning can play out in programmes, but the challenges suggest ways others can learn from and implement enhancements to curricula.

Rachel Milner (Chapter 2) outlines a research-intensive approach, 15 years in the making, to an undergraduate biochemistry programme at the University of Alberta, Canada, which has clear parallels with the Connected Curriculum. This holistic approach to education, Milner points out, encourages students to learn through research and enquiry, through a series of research modules across the undergraduate programme. The development has led to a cultural shift in the department, which now rewards contributions to education. Lack of reward and recognition in this area has been a surprising oversight in many universities, Milner argues (see also Fung and Gordon 2016). The department now also offers sustained funding to cover the costs associated with undergraduate research. After outlining the rationale for developing a research-intensive curriculum, Milner notes the practical factors and design interventions necessary for the success of the initiative and focuses on the implications for other departments, disciplines and universities.

James Wilson, Yao Wu, Jianmei Xie, Dawn Johnson and Henk Huijser (Chapter 3) offer a case study of a research-based curriculum intervention at Xi’an Jiaotong-Liverpool University. The authors outline
both the benefits and challenges of the research-oriented opportunities afforded by the 10-week Summer Undergraduate Research Fellowship (SURF) initiative. Although these opportunities are voluntary and outside the formal curriculum, they reflect the principles of the Connected Curriculum framework. In particular SURF offers opportunities to student groups, allowing them to connect with staff and learn about the institution’s research, to develop their research and critical thinking skills, and to share their research with a wider community, for example through a poster exhibition. Based at a joint UK–China research-intensive university, located in Suzhou, China, the authors highlight the adaptability of research-based models to different institutional and national contexts.

Thomas Kador, Helen Chatterjee and Leonie Hannan (Chapter 4) focus their chapter on object-based learning, which, like the core principle of the Connected Curriculum (learning through research and enquiry), is a curriculum design approach based on shared discovery and collaboration. Integrating objects into the learning process, especially from museums and collections, is a catalyst for empowering students to think about the production of knowledge. The authors argue that object-based learning can deconstruct unhelpful and inaccurate binary thinking between those who traditionally produce knowledge in the university (academic researchers) and those who passively receive that knowledge (students). Through engaging objects in a research-based environment, students generate original research and make a valuable contribution to the field. The authors highlight the benefits of students participating in object-based learning; they also discuss practical issues arising from engaging objects from UCL’s collections and museums. Finally, they draw on student feedback to illustrate the profound effect object-based learning has on students’ curiosity and development.

Recognising the importance (and often requirement of professional-regulating bodies) of foundation research and professionalism skills, Sharon Boyd, Andrew Gardiner, Claire Phillips, Jessie Paterson, Carolyn Morton, Fiona J. L. Brown and Iain J. Robbé (Chapter 5) outline an embedded research skills training course. Taken in the second year of a five-year veterinary science undergraduate programme, this curriculum feature prepares students for subsequent independent research projects, as well as for a thriving career. The design has clear links to the Connected Curriculum, with an emphasis on outward-facing public assessment (for example, poster presentations, exhibitions and blogs), on connections with both other students (for example through
peer assessment), and on the world of work. The Research Skills course creates the opportunity early on in the programme for students to develop their communication, interpersonal and leadership skills and, importantly, to be part of a research community of practice. The authors offer practical tips and advice and share lessons learned; their case study is wide reaching, with relevance to disciplines well beyond veterinary science.

Darren N. Nesbeth (Chapter 6) presents a case study on curriculum intervention in molecular biology at UCL. His topic is student participation in an annual international research event – the International Genetically Engineered Machines (iGEM) competition. Students work together and form connections across the STEM disciplines (Science, Technology, Engineering and Mathematics) to carry out a synthetic biology research project. The competition structure encourages teams to develop skills around computer modelling, laboratory practice, safe ethical practices, public engagement, website design and presentation skills (put to the test at the Jamboree event and exhibition). The collaboration requirements prepare students for common modes of working in commercial settings. Using an accessible trademarked DNA sequencing device, students with varying knowledge can engage in seemingly complex research processes that were previously out of reach for undergraduates. The investigations undertaken by students on iGEM connect work in academia with that of industry, resulting in patented and groundbreaking research.

In Chapter 7, Nicholas Grindle and Ben Thomas focus on the benefits to student learning in an object-based and practice-based setting. They outline a research-based art curation module, part of the Kent Print Collection at the University of Kent. Drawing on the module’s development over 10 years, the chapter shows the multiple benefits, including: increased motivation; leaving a legacy; engaging with previous cohorts’ collections; producing an exhibition for an external audience; connecting with employers and the general public; and learning the extensive employability skills that come with engaging in an assessment activity that parallels the kinds of practice expected in students’ future careers. The regular exhibitions mounted enable students to manage the entire process. The authors thus offer practical applications of research-based education and the connections students are able to create as a result of their active learning.

Denise Hawkes (Chapter 8) shares curriculum development work supported by funding from the Connected Curriculum initiative. This chapter outlines the development of online resources for research
projects in a professional doctorate programme at the UCL Institute of Education. Focusing on students at the thesis stage, Hawkes shows how creating online support enables students to learn practical skills and insights, while encouraging them to develop a self-sustaining community of practice that facilitates peer dialogue and support across cohorts, and geographical distances. The Education Doctorate programme is often completed part-time and by those with busy full-time careers in higher education, and student feedback shows that this online support is a much-valued way of forming connections and developing knowledge. Hawkes’ account reminds us that digital platforms in general are incredibly valuable, and will undoubtedly become increasingly important as we move towards more connective, research-based educational approaches (see also Chapter 13 in this volume).

Lynn Quinn and Jo-Anne Vorster (Chapter 9) outline how higher education can and should evolve to acknowledge the lived experiences and knowledges constructed in the global South. They focus on the changing context of higher education in South Africa following the fall of apartheid in 1994, and on the most recent passionate student protests calling for decolonisation of the curricula. Through outlining a number of case studies of enhanced curricula, Quinn and Vorster show how features of curriculum design can challenge learning dominated by the global North in general and European thinkers in particular; this new focus is more clearly connected to the lived experiences of the black majority. For example, students are encouraged to discuss learned topics in their African mother tongue, as well as in English. This helps shift the focus from an education designed to ensure that middle-class white students feel at home to one where local cultures are respected and valued. The examples and ‘stories’ outlined in the chapter offer practical ways of decolonising curricula in a variety of disciplines and contexts, relevant to educators well beyond the South African university system.

In Chapter 10, Elizabeth Cleaver and Derek Wills outline an institutional strategic change project from design through to implementation. Curriculum 2016+, at the University of Hull, UK, asks programme teams to come together to evaluate their education provision by thinking about programme themes, ‘big ideas’ and outcomes and the suitability of pedagogic approaches. Importantly, this approach centres on the student experience, with a rewrite of the programme documentation for students – making the implicit (‘big ideas’, approaches to teaching, and assessments) explicit – with the goal of giving graduates the necessary skills for successful careers. Through thinking about the design of programmes, staff members were also encouraged to make explicit
connection between their teaching and research, as well as coherent connections across disciplinary communities and to the world of work. The chapter goes on to outline how three programme teams adopted the strategic approach in their local disciplinary context, reviewing and designing change into their programmes of study.

Alison James (Chapter 11) makes explicit the links between research, enquiry and communities of practice. Learning by connecting, making and doing are approaches that employ social models of enquiry. Taking this as her focus, James looks at social learning in the creative disciplines, including fashion, arts, design and media. The chapter outlines how these disciplines demand human-centred learning which is best done by doing, making and getting stuck in – in other words, by enacting a constructionist model that develops both students themselves and their external links with the wider world. It is through the connective opportunities fostered by social learning that students can learn the skills needed for a thriving future and successful career, actively shaping their own education and development. The chapter offers several short vignettes of social learning from the University of the Arts London.

Shelley Fielden and Alison Ledger (Chapter 12) take as their focus the connections afforded by interprofessional healthcare education (IPE). Two case studies of IPE at the University of Leeds are outlined; one is unassessed and voluntary, the other is assessed and mandatory. The curriculum design features afford students multiple opportunities to connect with a range of universities and professions. Through themes such as patient safety, students, facilitators and patients come together in workshops and other settings. Along with the opportunity to network and learn to work with other professionals, healthcare students put into practice a range of learned key skills. The chapter outlines the difficulties, challenges and practicalities of organising this complex yet clearly beneficial set of connective opportunities for students. Student feedback suggests interacting with professionals is a key driver in high satisfaction.

In Chapter 13, Eileen Kennedy, Tim Neumann, Steve Rowett and Fiona Strawbridge explore the use of digital technology as an enabler in a thriving research-based education environment. Drawing on extensive research over two years with the community at UCL, which entailed investigating and examining the existing online learning environment, the authors arrive at a manifesto of sorts, outlining the demands for the future of virtual learning. ‘UCL Together’, their proposal for a ‘Connected Learning Environment’, will be a confederation of systems that will integrate with virtual learning environment (VLE) Moodle, including media creation, file storage, Wikipedia, video conferencing
and personal student webspace. It will also include a social network to enable connections between staff and students. The authors argue that this platform will help rigid boundaries become porous, allowing connections to be made across and through modules; such a system would allow, for instance, prospective students to sample course material, as well as enable connections with alumni and the world of business.

In Chapter 14, Elizabeth Marquis, Zeeshan Haqqee, Sabrina Kirby, Alexandra Liu, Varun Puri, Robert Cockcroft, Lori Goff and Kris Knorr focus on the Students as Partners initiative at McMaster University (Hamilton, Canada). They highlight the ways in which this institution-wide programme affords students opportunities to engage in research within and beyond the formal curriculum. Students engage in the scholarship of teaching and learning (SoTL) through their partnership with staff, as co-enquirers. In so doing, they conduct research, co-author papers, and present at national and international conferences. The chapter outlines the challenges of developing meaningful partnerships devoid of hierarchical structures. Student partnership is presented as a threshold concept for teaching and learning, and the authors characterise four case studies of partnership projects to highlight the experiences of both staff and students.

Keeping with the theme of students as partners, Chris Browne (Chapter 15) outlines an engineering curricular intervention at the Australian National University. The ‘jigsaw model’ encourages active student partnership and engagement, through small-group teaching and research, on a second year undergraduate programme. Students act as facilitators in the design of learning activities, which they then teach to their peers in tutorial setting. This requires research into the disciplinary content, and also pedagogic research into the scholarship of teaching and learning. Students learn content in tutorials and bring this back to both group projects, thereby building up a scaffold, or jigsaw, of knowledge. Sharing this with the group, students develop a dossier of knowledge and skills with which they can take on individual projects. The jigsaw classroom provides the structure for both course delivery and scaffolds assessment tasks, with students as active partners in enquiry-based learning, moving through identifying, producing, authoring and pursuing modes.

Finally, Chapter 16 offers 12 short vignettes of practice, to highlight a further series of ways in which engaging students with research and enquiry can enrich their learning experiences, preparing them not only for more advanced academic learning, but also for professional roles in complex, rapidly changing social contexts.