Towards a connected curriculum in architectural education: research-based education in practice

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ABSTRACT

This paper outlines a long-term flexible education strategy for integrating research and teaching at a research-intensive UK university. The "Connected Curriculum" is part of a recently launched twenty-year vision and a wholesale commitment to changing programmes of study. It will enable students to participate in research and enquiry throughout their education. In addition, it aims to allow students to make connections both vertically across a programme's year groups and horizontally across disciplinary divides, as well as beyond the university setting. The paper begins by outlining the Connected Curriculum, including its framework of six dimensions of connectivity. Then it moves to look specifically at research-based education in practice. In doing so it pulls together a number of relevant curricula examples from built environment disciplines and further afield, which have clear implications for architectural education. Through illustrating relevant international and interdisciplinary praxis, in the context of an internationally-recognised strategic approach, the aim of the paper is to inspire curricula enhancement relevant to diverse architecture programmes.

INTRODUCTION

Change is affecting higher education globally in a number of ways and universities must adopt flexible yet coherent strategies that prepare students with the skills needed for successful and thriving careers in an unpredictable future. A growing body of literature argues that one way this can be done is by enhancing synergies between teaching and research. Bringing students closer to research has a number of benefits relevant to students' current experiences and careers as graduates. These include motivating students through treating learning like research cited at the edge of knowledge discovered through collaborative and shared enquiry. University College London (UCL), a leading UK research-intensive university, has implemented a distinct research-based education strategy, known as "Connected Curriculum", which is increasingly drawing the attention of the international higher education community. This institution-wide approach focuses on making learning and assessment relevant to what students will do in their future careers and on facilitating opportunities for connections. Importantly, though, this strategy takes a non-prescriptive approach: it offers suggestions for research-based education in unique subject-based contexts. The focus of this paper, then, is to use the framework of the Connected Curriculum to inspire architecture educators to develop more enhanced research-based curricula.

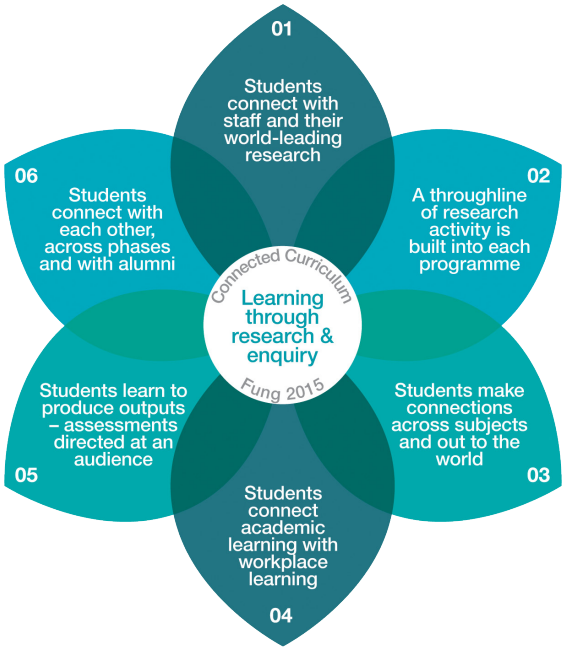
The discipline of architecture is ideally suited to lead the way in research-based education. In many ways learning and research already go hand in hand in architectural education. The design studio project is a strong example of collaborative and individual learning in a research setting. And through authentic assessment activities, students present to and engage the community beyond the university – specific points encouraged in the Connected Curriculum. Along with showcasing this and other strong examples already taking place, this paper also makes the case that there are ways in which architectural educators could enhance their own research-based offering. There is much to learn by looking beyond the limits of the discipline to strong curriculum design in other areas. It is argued that research-based education in architecture can contribute to and enhance an already established tradition of authentic learning in a community of practice.

The paper is conceptual in nature, however by way of secondary research it draws on an internationally-gathered collection of existing curricula enhancement case studies. It looks largely to the collection of case studies put together by of higher education consultants and developers Mick Healey and Alan Jenkins (2016), as well as from examples at UCL. The structure begins by both highlighting the value of research-based education as well as unpacking UCL's approach. Finally, using the flexible framework adopted by UCL, the last section zooms in to the practical level. It sets out a number of diverse curriculum enhancements that may inspire architecture programme leaders. While these are framed in the context of a UK institutional strategy, the examples are relevant beyond the local context and to other disciplines.

A RESEARCH-BASED EDUCATION STRATEGY: THE UCL CONNECTED CURRICULUM

UCL and other institutions are beginning to adopt research-based education strategies in response to a shifting higher education climate. Barnett suggests the role of the university is changing where it must increasingly prepare students with new ways of knowing, in order to thrive in an unknown future. He notes: "In an age of supercomplexity, a new epistemology for the university awaits, one that is open, bold, engaging, accessible, and conscious of its own insecurity. It is an epistemology for living amid uncertainty" (Barnett, 2000; see also Brew, 1999). Brew (2012) identifies other changes which are also affecting the way universities are operating, including the shift to massification (Elton, 1992; Westergaard, 1991) and time pressures on academics (Hattie and Marsh, 1996). A growing body of literature (Brew, 1999; Brew, 2012; Hattie and Marsh, 1996; Healey 2005) argues that bringing students closer to research, employing pedagogic approaches which engage learning as shared discovery or enquiry, will go a long way to improving contemporary education. Learning through research can deepen learning and understanding, especially when it enacts inquiry-based learning, and learning which closely parallels problems found in one's future career (Healey and Barnett, 2005; Healey and Roberts, 2004). The urge to bring teaching and research closer together is also driven by university managers to remove a long-standing binary which sees both areas as separate and unproductively disparate. This is evident with the ideas "teaching load" (what academics have to do) and research reward (what scholars are rewarded for doing) (see Fung and Gordon 2016). The challenge is for universities to reshape curricula so that staff and students can work together to treat learning as a journey; academics are further along the spectrum, and both staff and students develop through research and enquiry. Such an approach would reconceptualise higher education as "communities of practice" (Brew, 2012; Wenger, 1998).

The Connected Curriculum is UCL's institution-wide strategic approach to reinvigorate learning in this way. President and Provost Professor Michael Arthur remarks that "our



▲ **Figure 1** The Connected Curriculum Framework

top strategic priority for the next 20 years is to close the divide between teaching and research. We want to integrate research into every stage of…" education (Arthur, 2014). Recognising that the term "research" is discipline and subject specific, from the outset such a whole-institution approach encourages local and distinct adaptations. The Connected Curriculum framework (Fung, 2015a; Fung, 2015b; Fung, forthcoming a) was designed to operate as a flexible tool for programme leaders and others with a stake in education planning to think through the development of their offering (Figure 1). It also invites staff and students to "question critically the nature of evidence and knowledge production" in their own and in other subject fields (UCL, 2015d).

The core principle is that students learn through research and enquiry. Six dimensions of activity each branch out from this core, which invite teams to think about approaches to learning and opportunities for connecting learning beyond the classroom.

Dimension 1 encourages students to connect with staff and to learn about ongoing research. It hopes to both break down unproductive hierarchies between staff and students, with students able to ask questions, and to bring students closer to a part of university life that they traditionally never experience. Curiously the thing that drives institutional reputation is often removed from student experience. This is also about introducing students to many members of the research community of practice that they belong to.

Dimension 2 encourages a connected sequence of research activities throughout students' programmes. It is important for development and learner scaffolding (Rosenshine and Meister, 1992) that students have opportunities to learn through research and enquiry at every phase of their degree. While the "capstone" dissertation project is encouraged as a minimum, there should be structured opportunities to develop expertise in research throughout earlier years, both within the curriculum and through extra-curricular activities.

Dimension 3 recognises that research is inherently social, and in order to strengthen the community of practice opportunities need to be structured which encourage students to connect their learning across the subjects they are taking and with the wider world beyond. It would be unhelpful for students' future careers and lives if their education was not applicable to contexts beyond their immediate learning environment. Through this dimension students will have opportunities to connect with external organisations and communities.

Similar to dimension 3, students need opportunities to make connections between the research and learning they undertake on a course with what they will be doing in their future careers. Dimension 4 encourages students to connect academic learning with workplace learning, and in so doing will be able to develop a range of professional attributes and skills needed to succeed in modern work environments.

Dimension 5 focuses on assessments and invites programme teams to reconceptualise them as relevant and appropriate for the development of skills needed for students' future careers. Is an essay or unseen final exam actually the best form of assessment? Possibly in some cases, but ideally some assessments will engage an audience beyond the marker, giving students a voice beyond the immediate activity, including with the community, industry partners, or employers. Arguably students will also learn more useful transferrable digital skills, through, for example, producing a video or website. Motivation is a key factor in rethinking assessments as outputs, with many students excited about the possibilities.

Finally, dimension 6 encourages interpersonal connections. The ability to work with and connect with people from different disciplines, cultures, and backgrounds is an increasingly valuable skill in a globalised economy. Students need opportunities to connect with other students in upper and lower years, on other programmes, and with people beyond the university, including alumni. While these connections may need to happen naturally, structured opportunities within the curriculum will be needed in order to develop a thriving research community.

RESEARCH-BASED EDUCATION IN PRACTICE

The Connected Curriculum framework is sufficiently flexible yet thorough to inspire enhancement in architectural education (as well as all disciplines). The six dimensions discussed above are by no means new to pedagogic approaches that already exist. There is a strong tradition in architecture of students learning through research and enquiry. Importantly, Connected Curriculum aims to inspire further enhancement on the back of this firmly established approach to education, while encouraging authentic learning in a coherent community of practice.

If one thinks of architectural education, likely the image of design studio comes to mind; indeed, in many schools it dominates both staff and students' workload and energy. The studio, both timetabled learning hours and physical space, strongly fosters a research community. Students spend great lengths of time in the studio working on coursework, well beyond meeting with teachers about progress and feedback. For many students, desk space is also provided, which further adds to the sense of belonging. Students conduct practical research into the built environment, engaging websites, books, model making, computer drawing and experimentation. The dominance of the studio suggests that architecture students regularly engage in the core ideas of research-based education.

In line with the Connected Curriculum, studio learning can be linked to many of the framework's six dimensions; at UCL the goal is to enhance these dimensions where possible. Often course teachers establish a theme for the cohort's projects, which may be based on their own academic research; if so, students have the opportunity to learn through making connections with staff and their research (dimension 1). In that studio takes place at every step of the way, ideally building on the work of previous years, a throughline of research activity is firmly established (dimension 2). It is worth reminding students that studio is research and that it is a progressive journey of enquiry. In some cases, in line with dimension 3, studio is closely linked to work in other subjects, for instance architectural

history and theory or technology courses. Firmly situating and encouraging cross-subject connections reinforces the importance of learning in both subjects and allows students to develop through related yet distinct research projects. Aligning studio projects with other disciplines, for instance town planning, or engineering, further enhances connections relevant to students' current learning and essential skillset needed for future employment. Though setting research projects in studio that relate to what students will be doing in diverse careers (dimension 4), including but not only in architectural practices, students will gain practical job developmental skills which can be motivating and underscore the relevance of the learning exercise. The activity of inviting external critics to view coursework, where students present their projects to relevant interdisciplinary professionals (the "crit"), is a further strongpoint linked to dimension 4. Studio work often culminates in the production of outputs directed an an audience (dimension 5). As well as the interim and final crit presented to invited guests, it is increasingly popular for schools to showcase studio research in end-of-year exhibitions or shows (as illustrated in the now-lengthy UK summer architectural calendar). Finally, through the above noted studio pedagogic approaches, especially the end-of-year show, architecture students are able to make connections with each other, across phases and with alumni (dimension 6). Further opportunity to showcase studio work throughout the year and invite others to view work in progress would also encourage greater connections, leading to further motivation and a strengthened research community of practice. While studio is so firmly established, it and other architectural courses can be enhanced through looking to, and being inspired by, relevant international work on research-based education in practice. The following is just a small sample of the many ways research-based education could be adopted in practice.

DIMENSION 1: CONNECTIONS WITH STAFF AND THEIR RESEARCH

While the studio can bring students in contact with academic research, this is not a guarantee, and indeed it may be that the theme is driven simply by an interest in the area; further it may not introduce students to a wide range of the department's teaching staff. Structured opportunities for students to engage course leaders, and others in the department, are needed, which facilitate opportunities for diverse connections and introduce students to the strong research community they are part of. Some students do not realise academics even conduct research outside of their teaching commitments, others may feel that they are not allowed to even enquire about this. To overcome this unproductive binary between teaching and research at UCL there has been a history of creating induction-week activities which require students to enquire into staff research and report back on their findings. In the department of geography tutorial groups have been allocated a member of academic staff and each is then provided with three pieces of writing and a CV, and an interview is organised. Students then go off in small groups to read the material and devise interview questions to uncover the objectives of the interviewee's research. As well, students find out how the research relates to his or her earlier studies, and how it relates to current teaching, other interests and geography as a whole. Finally, students produce a short report on their findings (Dwyer, 2001; Healey and Jenkins, 2016 [all references are to case study numbers]).

Other areas of the university, such as the Faculty of Brain Sciences, have modified the approach. In this case students view polished, short videos of academics speaking about their research so that they can ask challenging questions about scholars' areas of expertise. Students are required to present on the findings (Fung, forthcoming b). The design of the activity means that students are able to develop a number of skills: teamwork skills; transferable skills such as project management and interviewing; and communication and presentations skills. Importantly, this exercise introduces students to the wider research

culture within the faculty (Standen, 2015). "Meet Your Researcher" (UCL, 2015e), as the idea is now known locally, which is adopted in various guises, is being encouraged in all departments; it would certainly suit architecture, where interesting yet diverse research is being conducted within one community.

The Science Faculty at McGill, Canada, has undertaken a similar but distinct sort of approach. Twice per academic year a handful of academic staff talk about their research in short casual presentations, and then students and staff have lunch together, informally discussing the research. This clearly works to break down unproductive binaries between staff and students, leading to the latter feeling comfortable enough to approach the former to ask questions.

Another way that students can make connections with staff and their research is by supporting the research itself. While research assistants are firmly established in some departments, designing an assessment activity could be a productive way to bring more students in contact with academics and their research. It is possible that students could even help with, for instance, data collection. This could have a number of ramifications for architecture, for example students could help gather GIS information and they could help conduct large-scale spatial studies through inputting data. One example from biology shows the scale and potential for motivating students. At the University of Sydney, Australia, a first year cohort of 1000 students carry out a small research project as part of a larger study of asthma across the metropolitan area. Students gather airborne fungal spores, in their backyards, over a ten-minute period. They learn how to identify the fungi and develop a distribution map of the spores. They then have the opportunity to discuss the cohort's findings with the scholar and international expert. The activity led to a better awareness of the research process and the course content (Healey and Jenkins, 2016; Taylor and Green, 2007).

DIMENSION 2: A THROUGHLINE OF RESEARCH ACTIVITY IS BUILT INTO THE PROGRAMME

As noted above, in order to strengthen a research community and remind students that they are contributing to a shared construction of knowledge, drawing attention to the throughline of research is essential. In some cases, it could mean renaming courses to make this explicit. In most cases holistically mapping a constantly evolving curriculum rarely happens, yet this may be a useful way in which to identify the demand for a research throughline.

At the University of Tasmania, Australia, a structured and logical progression of research learning takes place throughout the full three-year undergraduate programme. In the first year assessment activities allow students to engage with researcher positionality and institutional ethic applications. Students work with real research data in year two. In the final year dissertation research is supervised by academic staff and both work together to produce a research paper for an undergraduate journal (Healey and Jenkins, 2016). A teacher could run with this and set an assessment task to write an architecture journal article, in the style and requirements set by a publisher (see also UCL, 2015b). Or students could be assigned a project to investigate an architecture journal article and put questions to its author, engaging in possible dialogue with the scholar (Healey and Jenkins, 2016). While most architecture programmes are professionally accredited and rigid, a number of small interventions could be made to establish a throughline of research. Encouraging research community activities such as research seminars, departmental conferences, and student-led research journals and digital platforms for the dissemination of coursework would further reinforce the research community which students are a part of throughout

the duration of their studies. Moreover, these would not require major revisions to the programme structure.

DIMENSION 3: STUDENTS MAKE CONNECTIONS ACROSS SUBJECTS AND OUT TO THE WORLD

Through making practical connections between immediate learning and other courses and beyond, students will be better equipped to apply the skills of research and enquiry to global problems in the future. All first year engineering and computer science students on the Integrated Engineering Programme at UCL work on two five-week long research problems based on real challenges. This includes identifying the problem, designing the research project, and finding a solution. In that the problems are based on global challenges, such as sustainability and health, students work closely with teaching staff and external experts (Healey and Jenkins, 2016). These problem-based scenarios, situated in real global challenges, offer authentic learning similar to what graduates may do in their future careers.

Learning with objects is a closely related pedagogy also useful for encouraging students to make connections across their learning out to the world beyond (Chatterjee and Hannan, 2015). At the University of Strathclyde, UK, first year mechanical engineering students work closely with a car, disassembling it, and selecting a component for investigation. They research its functions, physics, design and manufacture, and produce a poster explaining their research (Healey and Jenkins, 2016). At UCL, similarly, second and third year architecture students recently visited the UCL archive collection. The studio group was investigating remoteness and were particularly interested in the story-telling abilities of artefacts. Students were able to view and handle a number of objects, including a rocket designed to be fired onto the Moon, a number of letters and photographs sent home from arctic explorers, and rocks from remote St Kilda, UK – the location of the group's upcoming site visit

Situating learning in the city or landscape is another key way students can make connections between course material and the world beyond in a research-based setting. Students in architecture, construction and project management and planning come together for a large first year course at UCL. "Making Cities" uses contemporary London as a research laboratory, with students required to investigate a component or area of the urban fabric through videography. Similarly, "Making History", also at UCL, encourages students to use the resources around them in the city – archives, documents, objects, collections, buildings, images, and soundscapes – to creatively investigate London's history (UCL, 2015a; Fung, forthcoming b).

DIMENSION 4: STUDENTS CONNECT ACADEMIC LEARNING WITH WORKPLACE LEARNING

Built environment disciplines tend to have close links with the community, which bolster connections between learning and work. Many engineering programmes are developed to work closely with firms who also help create assessment activities that respond to real community problems. Construction and project management programmes similarly work closely with industry and regularly schedule site visits. It is clear that employers benefit from educating the next generation of professionals: they want to be well-placed to hire new graduates. In architecture, students often see the link between studio work, or technology courses, with employment. It is clear to them that learning and assessment parallel tasks in work. However, the connections between other parts of their curriculum and workplace learning, such as architectural history and theory, may be less clear to students. The need

to reinforce the importance of foundational history goes without saying, but there may be other ways that help draw clear links with employment and which have the added benefit of increasing motivation. One is to encourage students to undertake historical projects that are needed or parallel the work of national historical societies for architecture. Could English Heritage, for instance, help identify essay topics or could historians from the organisation speak to architecture cohorts about their careers?

The Science Shop model has been well established in other countries and disciplines. It links up undergraduate students in need of a dissertation topic with civil organisations in need of research. It gives students an opportunity to lead their own research project, attempting to answer a real problem in the community. A key part of this is taking advantage of institutional support, public engagement teams and university volunteering departments, who are well-placed to understand the needs of the community and who are keen to encourage partnerships. Working on these real research problems gives students a way of applying their learning to what they may be doing in their careers, and supporting a charity with their expertise.

Like the Science Shop model, architecture students at The University of New South Wales, Australia, offer a relevant example of community engagement through research. Shaped by the needs of community partners, programme leaders set out a number of projects for students to work on solving in teams. After a research and design phase students then present their solutions back to the community (Healey and Jenkins, 2016). Students clearly see the relevance of their learning to what they may do in their careers; they understand the importance of research and enquiry and how it leads to design solutions.

DIMENSION 5: STUDENTS LEARN TO PRODUCE OUTPUTS – ASSESSMENTS DIRECTED AT AN AUDIENCE

Architecture education has many outward facing assessments; both the crit and the final year show (both discussed above) speak to the way in which assessments engage an audience beyond student and marker, producer and consumer. While many programmes have unseen final exams, in architecture this is usually not the case; summative marks tend to be awarded for final projects. Where architecture assessment activities could be revitalised is through exploring ways in which written assignments can serve a purpose beyond the immediate assessment activity and engage an audience beyond the marker. Little motivation can be found in writing an assignment solely for a marker, which then gets filed into an archive. One way students can engage an audience is through creating a Wikipedia page on a relevant previously-unreported component of architecture. Students could then follow it, and defend it through the review process. Another way is through drawing students' attention to research exhibition opportunities. The British Council for Undergraduate Research – paralleling similar national organisations in other countries – has been set up to give opportunities for students to showcase final-year research projects to a national community. A related Posters in Parliament event, allows a select number of students to present their research in a prestigious setting to Members of the UK Parliament. Even arranging a local undergraduate research conference (Healey and Jenkins, 2016) would allow students to think of their research as serving a purpose beyond the assessment activity. This would help strengthen a research community, and it would help students learn valuable presentation and research synthesising skills.

Fourth year anthropology students at McMaster University, Canada, work together to produce an edited book collection. The teacher sets the overall theme for the cohort, each student produces a chapter, and together they collectively learn about book proposals,

editing and production (Healey and Jenkins, 2016). The move to open-access and digital publishing may mean getting student work published could be even easier. To improve on this model, a course leader could assign the book topic in the first year, with three successive cohorts adding to the book. This would allow an internal selection process of the best chapters. A digital webspace or internal newspaper production, could allow full and more immediate publication.

Architecture students at UCL have a long history of producing assessments for an audience. In 2014 a group of second year students were given a brief to create an exhibition on a well-known and important architectural figure that once taught at the school, Reyner Banham. Throughout the term, students conducted research and designed a small exhibition which was mounted in the school's architectural library. Through uncovering local history, students were able to learn through research and enquiry and to produce an assessment activity that was outward facing and engaged a wide audience. Similarly, in 2015 a design studio group of students at UCL produced short films which were exhibited at one of London's Curzon Cinemas. The activity asked students to step out of the comfort of their familiar studio and to deploy their work in a public arena. In attendance were a number of invited guests, including filmmakers, artists, designers and architects, teachers, parents and friends. All guests were asked to both rank the films out of five stars and to offer a few words, which students were then able to put on their film posters. Students found the assessment activity quite entertaining and were proud to showcase their work to an audience.

DIMENSION 6: STUDENTS CONNECT WITH EACH OTHER, ACROSS PHASES AND WITH ALUMNI

The nature of the architectural crit, if it is open and welcoming of others, and the final year show, are two ways in which architecture students have opportunities to connect with each other. The challenge of connecting with alumni can be also overcome to some extent if architecture schools are active in encouraging graduates to return for these events. While there is likely room for improvement in many ways along these lines in architectural programmes, the "Making Cities" course at UCL, discussed above, which puts students in interdisciplinary teams is a structured example of encouraging students to connect across disciplines. In fact, understanding professional relationships in the built environment is one of its aims. As a first year first term course, students have the opportunity to understand how three professional disciplines contribute to the makeup of the built environment, and also to learn the challenges, rewards, and necessity of connecting across disciplinary boundaries (see also Edwards, Campkin and Arbaci, 2009).

Also at UCL, postgraduate students in the Development Planning Unit work closely with several sites in the global south. Each programme has a particular site and set of partners / community groups that they work with over three to five years. Students investigate the site, producing a policy brief detailing what could be done to ameliorate a problem. While the nature of the 12-month course, which includes just a short field trip to the site, is compressed, students connect with successive cohorts who in turn visit the site and monitor progress for continuity. What originally may have been a challenge, means that students are able to learn how to bring a project to a milestone in order to pass it on to others, while connecting with future generations that they do not even meet. This approach has also been taken in undergraduate courses in Science at UCL (Chang, 2007; Healey and Jenkins, 2016). Finding more innovative, structured, and serendipitous ways to allow students to connect with each other is an ongoing challenge.

CONCLUSION

This paper began by unpacking the UCL Connected Curriculum, an institutional response to research-based education, and its six dimensions of connectivity. It then went on to frame this in the context of tangible local, national and international curricula examples. In doing so it modestly aimed to inspire curricula enhancements in architecture and beyond. While architectural education has much to celebrate for its pedagogic innovation and its firmly established tradition of authentic learning in a community of practice, the principles of research-based education promises further enhancement. Designing architectural programmes that encourage curiosity, and that allow students to participate in research and enquiry in a community setting, will arguably enhance the student experience in a number of ways. Specifically, a Connected Curriculum in architectural education can: reduce unproductive hierarchies between student and teachers; foster a spirit of shared uncertainly in real problems; allow students to learn about and engage with a part of university esteem that often goes unnoticed; connect students across disciplines and years, as well as build links between students with alumni, employers and the community; and motivate students with assessments that both engage an external audience and are relevant to what one may do in an architectural career. Through realistic career-like problem-based learning, curricula should foster curiosity that speaks to the ways in which academic research is situated at the edge of knowledge. Through inculcating a spirit of community, establishing a department where students can engage in academic research, students will be able to participate in an authentic community of research practice. Finally, through valuable assessment activities, students will be able to contribute to the production of knowledge at their institution.

It is true that an institution-wide strategy of this size and duration may face its challenges and sceptics (UCL, 2015c), and that some students may be initially put off by its demands for collaboration and critical thinking, but as suggested above, the discipline of architectural education is already doing so much along these lines. Few will doubt that the Connected Curriculum's flexible dimensions of good research-based education will lead to a rewarding experience for all, and ultimately valued architectural graduates.

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Studies in Higher Education 16, no. 1: 23–28.