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Productive uncertainty: The pedagogical benefits of co-creating research in the design studio

Introduction

The concern raised by Boyer (1990) three decades ago, that an integrated approach to teaching and research would become a casualty of the pressure to publish, has recently been subverted. In the context of Covid-19, universities are revising workload models to increase teaching loads while reducing the time available for research. The frustrations long reported by academics, of

balancing these competing demands, are likely to reach unprecedented levels (***, 2017; Geshwind and Brostrom 2013). An integrated approach to research and teaching may be a useful strategy to support ongoing research in the design disciplines. This article employs teacher observations and student feedback to reflect critically on an iteratively-developed studio model created to produce original research in collaboration with masters-level architectural students. This recognises the capacity of postgraduate students to contribute valuably to contemporary research problems and, thus, optimise capacity. Research outcomes from the two, semester-long studios analysed herein included: a public exhibition, a peer-reviewed conference paper, an invited presentation to local government, two peer-reviewed journal articles in high-ranking journals (***, 2018; ***, 2018), and the facilitation of interdisciplinary research partnerships that resulted in the attainment of research funding via two successful, competitive grants.

Research-focused studios are not unusual within architectural education (Bates, Mitsogianni and Ramírez-Lovering, 2015; Jasper, 2014; Varnelis, 2007). These typically seek to provide the following learning outcomes: the skills to identify new questions that should be asked in the context of our built environment; the ability to obtain the knowledge necessary to propose solutions to those problems; and the confidence to propose them (Cuff, Higgins and Dahl, 2010; Healey, 2005; ***, 2018). Yet, while studio project outcomes are often published, the underlying pedagogical strategies that facilitate quality research outcomes are seldom discussed. Further, research-focused studios are often structured around real-world projects, with the project parameters clearly defined for students (Cuff, Higgins and Dahl, 2010; Woodcock and Stone, 2016). The interest of the studio model reported herein was what happens when the complexity characteristic of a design studio is deliberately intensified.

The design studio has inherent complexity because traditionally, and in accordance with professional accreditation bodies, students are expected to resolve a building design, attending to the way that it looks, feels, performs/ functions and complies. While the emphasis of individual design studios can vary, in broad terms, a design proposal at post-graduate level will be expected to demonstrate a synthesis of knowledge across multiple domains inclusive of aesthetics, economics, building science (engineering, watertightness etc), cultural context, environmental psychology, and the policy environment (building and planning regulations). Simultaneously a design proposal is expected to demonstrate the student's capacity for critical self-reflection (Ochsner 2000; Oztürk and Türkkan, 2006). Within the design process, a

decision made within one domain can throw up problems in another. For example, a decision about materials will have a bearing on aesthetics, watertightness, ease of construction and cost. The design process is thus dynamic, creating a constant back and forth of inter-dependant problem solving that students must learn to navigate (Oztürk and Türkkan, 2006).

Within the studios presented herein, the complexity students were asked to manage was intensified in three ways. Firstly, students were asked to work within the realm of hospital design and to project forward to imagine varying futures for this building type. Hospitals are large and highly complex buildings owing to the number of factors that require consideration within the design process: functional proximities and their relationship to patient flow; performance requirements related to infection control and surgical spaces; multiple stakeholders with varying needs including medical, research and administrative staff, patients and their families – and models of care that change between medical specialties; alongside the necessary integration of medical technologies that are subject to change. Secondly, students were asked to define their own research question and, thirdly, to propose the artefact best suited to answer that question - accepting that a building may not always be the best solution (Hyde, 2012; Rodgers & Bremner, 2013). Both studios presented formed the final (or cap-stone) studio of four studio courses comprising a Master of Architecture qualification. The model therefore assumes that a range of professional competencies related to architectural practice will have been covered in the three studios prior to the cap-stone studio, enabling the form of assessment within these studios to be negotiable. Notwithstanding our willingness to move beyond the requirement of a building design as the final assessment item, the negotiation of inter-dependant decisions across multiple domains, undertaken critically and underpinned by research, remained a consistent feature of these studios.

Providing the opportunity for students to manage intensified complexity is useful. It has been recognised that today's graduates will require an enhanced capacity for innovation and rapid adaption to change, relative to solving problems that are increasingly complex (Markauskaite & Goodyear, 2016; Noordegraaf, 2011; Pink, 2005). Similarly, Rodgers & Bremner (2013, p. 157) have drawn attention to the ability work productively within a state of 'not knowing' relative to contemporary challenges such as climate change. While Markauskaite and Goodyear (2016) have argued that students will benefit from opportunities to manage complexity within learning environments authentic to their future professional roles, Griffiths (2004, p.723) has observed that higher education for the professions is typically focused on imparting knowledge

about ‘how to do the job’ instead of obtaining the skills required to ‘recognise and handle complexity, uncertainty and contested concepts.’ The studio environment cannot expose students to the full process of design, collaboration and negotiation, required over several months (sometimes years), that is necessary to bring a project to fruition. Many design educators, however, share a desire to utilise the studio to expose students to the kind of expertise required to move beyond accepted design practice; to employ their professional skillset to affect broader, positive change within the built environment (Bates, Mitsogianni and Ramírez-Lovering, 2015; Cuff, Higgins and Dahl, 2010; Jedenov and Afonso, 2017; ****, 2020). Leadership in any profession requires a willingness to engage in, and manage, uncertainty. This willingness is also necessary for the production of original research. Yet the stress associated with working in an uncertain environment can be unproductive for student learning. In the design studio uncertainty can overwhelm students, leading to ‘designer’s block’ (or design paralysis) – colloquialisms that refer to the process of students becoming so overwhelmed by research that they are unable to create work (****, 2020). This article details a set of pedagogical strategies that were developed to assist students in learning to manage the stress of uncertainty to ensure the pursuit of new research was equally productive for student learning.

Design-led research as a method for pedagogical development

Studio learning typically comprises a small cohort teaching environment that employs a cognitive apprenticeship approach to learning (Collins, Brown, & Newman, 1989). Students obtain continuous, formative feedback from the teacher, once or twice weekly, throughout the process of developing an individual or small group design project. Architectural design studios typically follow two formats. In more traditional formats, students will be asked to design a building in response to a brief that mimics real-world practice. For example, an apartment building where the client, functional programme and site are defined by the teacher, but where students are expected to bring their own interests to enrich their design response. While high performing students will still push the boundaries of existing practice, seldom do these studios produce new knowledge. The second studio format is more speculative, seeking to challenge the limitations of existing design practice. A speculative studio on apartment design, for example, might ask students to interrogate what it would mean to design an apartment building underwater, or within an active war zone. The shifting of an ordinary design problem to an extreme context encourages new thinking around that building type and how humans might inhabit it.

The first studio discussed herein was motived by the teachers' involvement in research about contemporary children's hospital design. We hoped students could suspend some of the real-world limitations that we couldn't, to speculate on the future of hospital design. Medical technology for example, heavily influences design practice but will be superseded by solutions we cannot predict. 3D-printed organs and robot-doctors are already plausible but what more is possible, and what avenues would this open – or close – for architecture? We hoped the artefacts produced by students could facilitate new conversations for future of healthcare. For students, this presented an opportunity to identify ways of applying their unique disciplinary skills to problems *beyond* the boundaries of architecture; to raise new questions regarding how design practice contributes to broader societal issues around healthcare delivery.

The studio is useful for responding to complex, ill-defined problems because it is underpinned by the practice of design-thinking (Cross, 2011; Dorst, 2011). Designers learn by 'making decisions and observing their consequences', exploiting the design process to advance understanding; as outlined by Edelson (2002, p.106-109):

(1) A design problem is identified relative to a need or opportunity,
(2) An initial response is formed that addresses the 'challenges, constraints and opportunities presented by the design context',
(3) This response is refined through 'iterative cycles of design and implementation, using each implementation as an opportunity to collect data to inform subsequent design.'

While the above steps outline the studio learning process, it also outlines the process educators go through when designing curriculum. *** (2016) have observed that curriculum design is itself a complex problem which frustrates a clear solution from being apprehended at the outset. They suggest identifying the 'misfit' within a learning scenario to enable the design process to be started from a part of the problem that is known. The misfit in our studio was the sheer complexity of hospital buildings (as outlined within the introduction); how could we resource students so they could rapidly obtain adequate knowledge of what hospital design required, in order to have the confidence to challenge existing practice – and all within twelve weeks?[1]

An innovative model, for a prison design studio, was adapted from the first author's own experience as an undergraduate student.[2] Like hospitals, prisons are a complex building type to tackle within the design studio but for different reasons. Prisons have complex functional

requirements relative to security and safety, both for staff and inmates. They are culturally charged and polarising, variously viewed as a site where vulnerable members of the community can undergo rehabilitation, and a means of protecting the wider community from the potential of further harm inflicted by those same members. The prison studio asked students to challenge contemporary design approaches by exposing them to user groups with fundamentally different needs - prisoners and staff. To facilitate understanding, students were resourced via key readings, selected for their ability to foster empathy with the prisoner as end-user, alongside guest seminars by reformed offenders, and a guard from a maximum-security prison. In keeping with Edelson's three steps, we first identified a curriculum design challenge, proposed and tested our solution (the hospital studio), then refined our curriculum model in a subsequent studio (the palliative care studio). Data was collected on both studios to form the basis for refining the curriculum design (Fig. 1)

Method for data collection

A number of curriculum changes were made between the hospital and palliative care studios that were informed by teacher observations and data obtained from student surveys. For the hospital studio (n= 19 students), surveys were administered (in class) during week eleven of semester (response rate = 63 per cent). This was followed by a longitudinal survey, administered via email, twelve-months following studio completion (response rate = 21 per cent). For the palliative care studio (n = 16 students), surveys were administered at mid-semester, during week six (response rate = 75 per cent), and during week eleven of semester (response rate = 56 per cent). Although administered in class, response rates were below 100 per cent owing to voluntary student participation and because attendance was only mandatory for only 80 per cent of studio sessions. The longitudinal survey was emailed six-months following studio completion (response rate = 25 per cent). Longitudinal surveys were aimed to capture longer-term learning outcomes; lower response rates reflect the loss of email contact with many students following graduation.

What drove curriculum change was that, although the hospital studio was ultimately successful, relative to the overall quality of student projects submitted at the end of semester, progress was painful owing to the complexity of this building type. This was exacerbated as no limitations were set relative to individual topic choice. No two projects were the same. Two examples from the nineteen projects included: a city-scaled breathing apparatus to be retrofitted to high rises in Beijing to improve air quality; and a set of pop-up blood centres – fully robotic, these

would be embedded with (imagined) future technology to both collect blood donations and provide instantaneous test results to patients. The limitless nature of the hospital studio was not only overwhelming for students, the resulting diversity made it challenging to teach; a significantly higher number of teaching hours were spent than were allocated for the course. The palliative care studio remedied this situation by restricting students to one aspect of healthcare design – the spaces in which palliative care is delivered. This did not limit creativity. Two examples from these sixteen projects included: a space for bereaved children to grieve through play; and retrofitting a stadium to enable patients to attend sporting events in their hospital beds during end-of-life care.

Strategies for creating a productively uncertain learning environment

Within the prison studio model which we adapted for use, students were provided with different stakeholder perspectives via core readings and interdisciplinary guest seminars. In 2000, when that studio was run, interdisciplinary engagement was an inspired approach relative to assisting students in coming to grips with the complexity of that building type. In contemporary studio teaching, inviting stakeholders and/ or experts relative to a particular building type, to engage with students has become more common (***, 2020). While the interdisciplinary engagement was both inspired and valuable within the prison studio, it did not prove sufficient to overcome the problem of design paralysis. Students became so overwhelmed that several weeks passed in which they felt unable to make progress on their design work. This section outlines a number of strategies we developed for mitigating design paralysis within the hospital, and subsequent palliative care studio, in order to increase learning productivity by making more manageable this uncertainty for students.

Interdisciplinary collaboration

Both studios incorporated a four-week, seminar-based research intensive where guests were invited to contribute short seminars. The hospital studio suffered from an accidental weighting towards designed-based expertise with seminar contributors that included: hospital architects, clinicians, researchers in the design of contemporary healthcare environments and an environmental psychologist. This occurred because we sourced contributors opportunistically from our existing networks. This was rectified within the palliative care studio by engaging (voluntarily) a practitioner-based research organisation to broker connections to specialist expertise: palliative care physicians, a music therapist, psychiatrist, nurse, medical education expert, a patient-experiences researcher (oncology), an environmental psychologist and a

health strategy planner from local government. Engaging end-users could not be justified ethically, so core readings were targeted to provide insights into the patient and family experience. In contemporary studios, engagement with stakeholders and experts is typically restricted to having these guests provide presentations and attend formal reviews ('crits'), where students present their final design for feedback. However, time pressures at formal presentations prevent the depth of understanding that could be achieved during a more informal, one-on-one conversation about the student's work. Interdisciplinary engagement was thus optimised within the both the hospital and palliative care studios by inviting expert contributors to attend informal workshops and interim presentations throughout the semester, enabling students to receive regular feedback from these experts on their design proposals as they were being developed.

Markauskaite and Goodyear (2016) have suggested that a better understanding of how knowledge is created and utilised by different disciplines is a necessary to foster stronger leadership within the professions. The teaching team observed three benefits arising from this interdisciplinary engagement:

(1) contributors revealed to students when they were making assumptions about their intended end-users and were able to supply the knowledge required to more usefully inform design responses.
(2) presenting to professionals without design expertise required students to adjust their communication strategies, both verbal and visual, to ensure their projects were properly understood.
(3) because a guest critic will bring their own biases and agendas to a work, engaging with a broad array of professionals forced students to identify which feedback was relevant and needed to be responded to. Conversely, how to productively address any criticisms they felt were beyond the scope of the design project (or research question) they had set up. This provided an opportunity to develop professional ways of being since students were required to position their own knowledge, skills and ways of seeing in relation to those with different professional backgrounds.

Within the hospital studio 66 per cent of students rated the guest seminars useful. This rose to 83 per cent in the palliative care studio with the more diverse and better targeted expert engagement. Seventy five per cent of students in the first studio rated the expert feedback obtained on their projects as 'very helpful', whereas 100 per cent of students within the second

studio answered yes to the question 'did the mix of professional expertise help to better inform your understanding of the design problem and /or end-user?' Student comments included:

> *It was useful having a professional to look at your work and from their perspective how it could be improved.*
>
> *Though I still can't express my ideas clearly, I learnt from these experts to use diagrams to express my ideas.*
>
> *Speaking to researchers was extremely helpful because the areas of research they were able to draw on significantly enriched my design.*

Supporting productivity and understanding through assessment tasks

To mitigate design paralysis, the hospital studio incorporated six idea generation workshops. This ensured work continued to be generated, avoiding a situation where students could feel overwhelmed by the scale of the problem. This also provided an opportunity to put the knowledge obtained from seminars directly into action. Working in groups of three, students had 60 minutes to create a sketch design and present it back to the class. One workshop, for example, asked students to rethink the way a paediatric ward is configured to improve social interaction between patients and to capture their imaginations. By focusing on the faciliatory role of design, these tasks hoped to shift student thinking past conventional design responses; to provide students with low-risk opportunities to experiment with the kind of unorthodox thinking the studio sought to encourage. Seventy five per cent of students reported finding these useful as they 'provided an opportunity to try out the [seminar] ideas immediately' and 'made us design quickly and very differently because technical requirements were suspended.' However, a major criticism of this approach, given that students would go on to identify their own design problem to pursue for their major project, was that these exercises were irrelevant to those individual projects and that they took up too much time.

Within the palliative care studio, only one idea generation workshop was held (not six), and two individual formative exercises were added to the programme. The formative tasks occurred concurrently with the research intensive phase (Fig. 2). Designed in consultation with our partner organisation, these tasks were aimed at putting students 'in the shoes' of their end-users in so far as was possible. The first task asked students to rethink a piece of medical equipment typically used within the home (for outpatient palliative care) relative to mitigating its

psychological intrusion into the domestic space. The second task asked students to brainstorm potential co-locations for palliative care facilities. Both tasks took students out of the mindset of proposing 'a building' as the solution. Asking them, instead, to focus on the faciliatory capacity of design; how could pairing an inpatient care unit with an art gallery or pet care centre, for example, provide new opportunities for public awareness, patient wellbeing or family support? Students could thus target these formative tasks towards the specific patient group they were interested in using as a 'client' for their final design project. Examples of clients included patients requiring kidney dialysis and adolescents engaged in palliative care. 67 per cent of students found these formative tasks useful.

Discussion to assist understanding

To the palliative care studio, we added 60-minute class discussion sessions after the seminars. Our efforts to mitigate design paralysis in the hospital studio, by speeding up the design process, had removed the space students needed to cognitively process the reception of so much new knowledge. The discussion sessions enabled students to more explicitly understand the relationship of the seminar content to the core readings, whilst providing the opportunity to work through both the relevance, and challenging nature, of this information as a group. 67 per cent of students reported finding these discussion sessions useful.

Providing a practise run

A second addition to this studio was a two-week group design task. Conducted in teams of three, students were asked to design a twelve-bed hospice inside two weeks. This was essentially a 'practice run' for their final project but on a tight timeframe. By comparison, seven weeks was devoted to the completion of their major individual assessment. The practise run enabled students to harness the resources of a group to quickly come to grips with what types of information needed to be sought and incorporated into a functional brief for a small hospice, and to rapidly prototype a variety of ideas in response to this. The resulting group projects included: a hospice located inside the city's major art gallery; another in the botanic gardens; a beachside hospice for adolescents; a paediatric hospice within a cancer research centre; and a hospice floating on a lake. The group exercise was intended to help students navigate the complexity of medical facilities. This had been a major stumbling block of the first studio. The short time frame forced rapid production that prevented students from blocking their own progress by overthinking the assessment.

This task was not popular. Only 16 per cent of students felt it helped make the scale of the problem more manageable, while 33 per cent felt neutral about the exercise and 50 per cent expressed negativity; the group exercise was 'two weeks wasted' and 'not overly useful.' We hoped that, with time, students would come to appreciate the value of this exercise, but we saw only a marginal increase in appreciation in the surveys conducted six months following the studio. However, the teaching team observed something different. The task provided students a low-risk opportunity to fail productively (as per Kapur, 2015) - and everybody did. A set of rich conceptual design ideas, all capable of challenging the status quo, were articulated as banal architectural responses. Faced with the complex functional demands of a hospice, all five teams resorted to convention. This enabled the students to obtain a tangible understanding of how easily a promising idea can be debased if time is spent unwisely, such as planning corridors and storage spaces, instead of maintaining focus on conveying the heart of the project. This experience imparted an awareness of the preciousness of time as a resource, and the need to think more strategically about how and where to spend it relative to their major assessment.

Evaluating success: learnings from the longitudinal surveys

Surveys conducted 6-12 months following these studios gave students the opportunity to reflect on longer-term learning benefits. Responses suggested that interdisciplinary collaboration encouraged a greater understanding of the professional agency of the architect:

> *I have learnt how to share data and collect ideas from different people … if everyone shares the resources at the beginning it will help us to step out of the box which is critical for architectural thinking. I have also learnt how to do research from a broader perspective … as a designer we should not limit ourselves to research from our own disciplinary field.*
>
> *A better understanding of the whole project and relative background information will make the later design much easier… when I recall all the studios I did, I found this studio was actually the most unstruggling [sic] as I knew what I wanted to do and what I could do.*
>
> *The studio equipped me with new critical thinking skills which encourage more in-depth considered responses that move beyond superficial treatments… It can be frustrating, as a recent graduate, to have depth in consideration but not be able to action that due to workplace hierarchy.*

A further indicator of the success of these studios was the suitability of this student work for dissemination. The hospital studio generated six from nineteen projects (32 per cent) that challenged existing design practice sufficiently that they could be written up as new research within peer-reviewed academic journals (***, 2017; ***, 2018). Despite the many changes to the second studio, the percentage of projects suitable for publication remained the same. However, both studios facilitated opportunities for public engagement; we were invited to present student work to local government and to exhibit it in the gallery of a major city hospital. Importantly, both studios also facilitated the formation of new interdisciplinary research partnerships that led to two successful research grant outcomes.

Negotiating the challenges of inquiry-focused partnerships

In creating a learning environment that was productively uncertain we had to assume dual roles as both teacher and research partner. This created several challenges. Firstly, how to mitigate the power-differential between teacher and student to allow a research 'partnership' to flourish. Secondly, how to navigate conflicts that can arise between the value of a piece of student work for advancing conversations for the research field versus its value as a piece of assessment in a professional degree. This speaks to a number of ethical considerations including the management of intellectual property, and safeguarding objectivity during assessment. In this section we outline strategies to navigate these challenges.

Minimising the power differential

Minimising the power differential between teachers and students is critical for success in co-inquiry practices (Griffiths, 2004; Matthews, 2017; Ahmad et al. 2017). However, as Fielding (2004, p.309) has argued, expectations that power might be 'equally shared' in the class room are idealistic: 'there are no spaces, physical or metaphorical, where students and staff meet one another as equals, as genuine partners in shared undertaking of making meaning of their work together.' To facilitate teachers and students working together in a less hierarchical, more collaborative manner, for both studios, research areas were identified just beyond the immediate expertise of the teachers. All had some theoretical knowledge of hospitals, but neither was an experienced hospital or palliative care architect. Students needed to develop the skills to tackle problems with no known answers. If they believed the teachers could simply supply the answers, the process would not be authentic. Understanding the likely success of a proposed solution requires consultation, or prototyping, with allied disciplines and/or end users. The interdisciplinary contributors strengthened student learning because they

demonstrated that no one person, or discipline, can be in possession of all of the expertise necessary to solve a complex problem. The palliative care physicians, for example, contributed a wealth of expertise but were upfront in acknowledging they did not fully comprehend all the ways that architecture can impact patient care. Shifting research questions between the two studios ensured both teacher and student could embark on the process in a relationship that more closely resembled the kind seen in professional, or post-doctoral research practice, where ideas are shared freely in pursuit of a common goal, but not necessarily with workload parity. Working this way can seem uncomfortable for teachers' but, as Boler (1999) has stressed, there is value in finding ways to share the discomfort and vulnerability students are likely to feel in transformative learning environments (****, 2017).

Prioritise student learning and desire/s for a project outcome above the desire for publishable research

Driving these studios was a desire to generate artefacts that could open new lines of conversation about the nature and future of health care design. Conflicts arose between the value of a piece of student work for assessment versus its value as publishable research. The prescribed outcome in a masters-level architectural studio, as determined by professional accreditation bodies, is a resolved architectural proposal underpinned by research. Essentially, a research argument framed through a piece of architecture. Most students designed a building. However, a handful of projects challenged this expectation, and these were the most promising projects in terms of publishable research. Examples included a public relations campaign for euthanasia; a film that explored oncology waiting rooms as containers of complex emotions; and a guideline for redesigning urban environments with greater sensitivity toward dementia. The ambition of these projects could easily have translated to marks upwards of 80 per cent but they also carried a much higher risk of failure than traditional projects. Partially because these students were willing to follow a line of research without knowing what the most suitable final artefact for assessment would be, and left open this possibility for as long as possible. But, also because faculty assessment guidelines, alongside the members of moderation panels, might be unwilling to assess the value of these projects commensurate with the value that we (as the teachers) perceived.

We addressed this challenge with honest communication. Articulating that the risk of pursing these kinds of projects is that they can fall short of expectations, so we asked students to contemplate whether they could live with a grade as low as 60 per cent. If the answer was no,

we recommended they stick to designing a building. We articulated our view, that there are more valuable, longer-term learning benefits presented by working this way which have little to do with a number on a transcript. But we had to also remain sympathetic to the students' desires for a project outcome, particularly, as the students who had the confidence to attempt these kinds of projects were used to obtaining grades around 80 per cent.

While disappointment over a grade will eventually subside, the skills developed from succeeding within an environment of intensified uncertainty will reap benefits well into a professional career. While Bovill et al. (2016, 199) have cautioned that students should not be asked to work 'far beyond their expertise,' it is worth highlighting that graduates will not have the luxury of this choice upon entering the architectural profession. There is real value in modelling to students how an expert manages the uncertainty associated with entering a new domain, while simultaneously providing them opportunities manage uncertainty themselves. However, we had to accept that it may take some time before students appreciate these benefits. One student, when asked six months later how they felt about their final project, said:

> *I'm happy with the research behind the project and opportunities to continue that research in the future (i.e. publishing a journal article). However, I was not happy with how the project was received at my presentation. My project was very different to the other studios where the outcomes are 'architectural'.*

Safeguard objectivity in the assessment of student work

Academic career progression is reliant on publications. Therefore, within courses where teachers are both guiding the production of, and grading, work that has the potential for publication, a conflict of interest is present. It should equally be recognised, however, that academic career progression is also reliant on measures of student satisfaction; a factor equally likely to generate compromise in the current 'student as consumer' market (Curran, 2017; Bovill et al. 2016). Despite moderation processes which aim to provide a quality assurance mechanism within architectural education, the fair and equitable treatment of students still predominantly relies on trusting teaching staff to deliver this. The pedagogical model we've outlined herein, does not, therefore, necessarily deviate from the challenges faced in ordinary, everyday teaching practice. Both of these studios were co-taught (two teachers working together) which provided an inbuilt mechanism for discussing and debating student marks. We also made active use of input from guest critics and studio contributors in assessing student

work, as is common practice within architecture studios given the subjective nature of the work produced for assessment.

Early communication of intentions regarding intellectual property

Unlike science, where the engagement of students within research production is accepted practice with a set of ethical guidelines for how these research partnerships should proceed, such processes are not yet established within architectural education. We thus encountered resistance to this approach from some colleagues, in particular, a concern that we might exploit students. This concern is not unjust as it is not unusual for academics to informally publish work created within the design studio (at conferences, on blogs and websites) without providing details of the procedure through which students provided permission for their work to be used; or whether an ethics agreement was in place surrounding the use of student work. Forward planning, communication and transparency are key in engaging in students within research partnerships.

The research agenda underpinning both studios was articulated to students from the outset and our intention to publish and/ or publicly exhibit student work was made explicit, as were the intended arrangements around intellectual property. IP remained with the individual student and they were at liberty to decline the publication of their work without this affecting their academic performance. Furthermore, no work was discussed, at conferences or within publications, until well after the semester had been completed, and time frames for marking, moderation and contesting a final grade had passed. Following course completion students from the hospital studio were given the universities standard-issue publication release form to sign if they were happy to do so. While this seemed straightforward, the mistake we made was in assuming an institutions' publication release form would include protections in the best interests of the student. Yet, in signing this document, students relinquished their IP, in its entirety, to the teaching team. Although we personally assured students that we had no interest in restricting their personal right to publication of this work, our position could not be enshrined within the wording of the document. Within the second studio we intended to circumvent this challenge by co-authoring journal articles with students so that IP agreements would, instead, be signed direct between the students in question and the publishers. This approach proved unrealistic, however; once students entered professional practice time scarcity prevent them from contributing to the publication of their work. Our experience provides a suitable argument for customised documents created in advance of undertaking research with students.

Questions of authorship in architecture are similarly less straightforward than in science as, depending on a student's career aspirations, a published peer-review of their design work may be more valuable to them than being co-author to an academic journal article. Expectations and practices around the protection of student anonymity within academic literature come into conflict, both relative to the proper attribution of creative works and requests by journal reviewers to provide visual examples of student work to accompany publications. We maintain separate strategies for publications related to a student's learning process versus those directly referencing the works they have produced. For the former, student information is de-identified in keeping with expectations for educational research, with any requests to supply images declined in accordance with this. For the later, student work is clearly attributed as would occur within a review of a built architectural project.

Conclusion

Given the challenges of our current academic climate, an integrated approach to teaching and research, that harnesses the creative capacity of post-graduate students to enrich research, could offer real value for the design disciplines. Contemporary higher education also acknowledges that global challenges are increasing in complexity and, thus, students require opportunities to learn to productively manage this complexity. Structuring the design studio around a research question both student and teacher have a vested interested in pursuing, but for which neither possess a pre-existing depth of knowledge, can minimise the power differential to position student and teacher closer together within a research journey. This approach recognises that a teacher's ability to navigate complexity is a valuable skill to impart to students, while facilitating the type of collaborative relationships more common to professional practice and doctoral supervision. Whilst valuable, this places educators in the challenging position of balancing a dual role as teacher and research partner.

Several strategies can help to manage the challenges that arise from this. Student learning and student desires for a project outcome must be prioritised above the desire for publishable research. Teachers and students should have honest, and ongoing, discussions around their respective values for the project to ensure alignment with student expectations. Teachers must also take seriously their responsibility to mitigate student failure. Generous interdisciplinary engagement should be paired with sufficient time for discussion and prototyping - and thus cognitive digestion - of the research problem students are being asked to navigate. Learning

and assessment tasks should be authentic to the student's future profession but also enable them to push the boundaries of accepted, contemporary practice. These must also be designed with the intent of making more manageable the complexity of the research problem. The alignment of the artefacts proposed by students for assessment should be consistently monitored against course accreditation requirements. Intentions around intellectual property should be carefully considered, well in advance of the studio proceeding, and clearly communicated to students upfront. Lastly, teachers should also make full use of existing institutional safeguards, such as guest critique and moderation, for maintaining objectivity within the assessment process.

Notes

[1] Our semester included twelve weeks contact time, a two-week mid-semester break, and a week of non-contact time prior to hand in of the final assessment.

[2] This studio was taught by practising architect *** at the University of *** (2000). His studio model has not been previously reported on except within a conference paper by author one (***, 2017).

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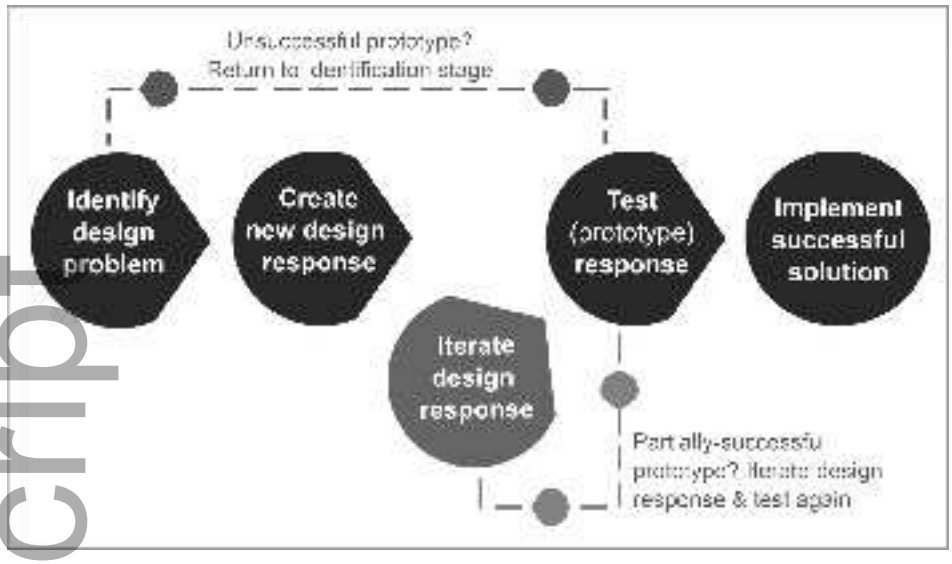

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