Responsible Design - an experiment in collaboration

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Cover Page Footnote

Jennifer Boyer (former Assistant Head of School) who lead on the development of the MArch programme curriculum and implemented the framework to allow this collaborative studio to emerge. Our Dublin School of Architecture colleagues, Anthony Hayes, Timothy O'Leary, Kevin Donovan, Kirk McCormack, Alberta Congeduti, Malachy Matthews, who contribute specialised consultancy to the students. External consultants who act as critical friends in the studio delivery, including among others Peter Crowley (Architect PAC Studios), John Piggott (Structural Engineer, CORA), Chris Croly (Environmental Engineer), Neil Colin (QS) Edith Blennerhassett (Environmental Engineer), Paul Hegarty (QS), Kieran Morley (Engineer)

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Abstract

The imminent impact of the climate change has forced architecture schools to rethink their pedagogic structures. Using a scaffolded approach in our new MArch studio, we can demonstrate that the multiple narratives are required to deliver a responsive building capable of being durable, resilient and flexible. We argue that understanding these intertwined narratives is an essential method in dealing with the dynamic character of a building under construction, in use and reuse. The paper plots the structured narrative in a necessary linear fashion, where each phase employs specific methods of enquiry to deliver quantitative data that supports evidenced design decisions. However measurement is not everything, because the student teams must find a way of balancing the objective with the qualitative. The studio remains an open looped learning paradigm where the students are encouraged to reflect on the processes to build for themselves a leadership and decision model for future practice. This is an iterative cyclical model where invention, crisis and paradigm shift are built in. Through learning histories (both shared and personal), through storytelling (Roth & Kleiner, 1998), the story of the MArch Collaborative Studio at TU Dublin is revealed.

Introduction

Though we would not know it from various histories; Architecture is a dynamic system whose value is only measurable when measured. Whilst this may seem obvious, in a culture in which judgement tends toward the enigmatic and emotive, measurement is often an alien concept in architectural education. A building, contrary to impressions, is never complete or anchored in time and space. As the thing that is moulded by us and in turn moulds us, it requires a more responsible approach to the creation of the fabric of our lives. If we accept the argument that architecture is a dynamic system then as conditions change then so must the measurements. We should also be aware that how we measure also changes how we perceive value. In architectural education we know that the process that gives rise to architecture is itself fluid and messy and often defies explication. The enfolded nature of these twin dynamic characters, the changing nature of the building and its creation, is the subject of this paper. Through learning histories (both shared and personal), through storytelling (Roth & Kleiner, 1998), this is the story of the MArch Collaborative Studio at TU Dublin.

Context

The Collaborative Design Studio is one of the introductory modules of the school's[1], new Master of Architecture programme.[2] The module is paired with a supporting theoretical module Whole Life Design. The modules are designed to form a cognitive break with the *'business as usual'* architectural studio model that has dominated pedagogic modes since the Bauhaus. As a model predicated on earlier 19th century studio practices we believe it is time for a re-think. This was an overdue and necessary redesign but due to the criticality around the '*Climate emergency'*[3] it has received fresh impetus. The MArch development team has worked on developing a programme that expressly aims to provide students with the means to reflect and re-direct if necessary their future pathway and facilitate their individual professional development.

Objectives of the Collaborative Design Studio Module

In this module students work in groups of four, to collaboratively develop a comprehensive, well researched, evidenced and reasoned design response to the given brief. The studio brief positions the challenge on an existing building, and proposes a change of use as well as the expansion or significant adaption of the existing structure. As with all wicked problems, the brief acknowledges that there is no one ideal response to the proposition and instead prioritises a scaffolded iteration of development through a series of prescribed design phases. As part of this iterative design process the original professional design for the existing building are involved in reviewing and propelling the work at key project stages.

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[1] Dublin School of Architecture at Technological University Dublin

[2] The MArch programme has just received approval from the professional body of architects in Ireland, the Royal Institute of Architects of Ireland (RIAI).

[3] The term *Climate emergency* originated in protests against *Climate Change* prior to 2010. *Climate Change* itself replaced the earlier use of *Global Warming,* as the Union of Concerned Scientists forecasted that the impact of increases in atmospheric temperature would bring about *Climate Modification*.
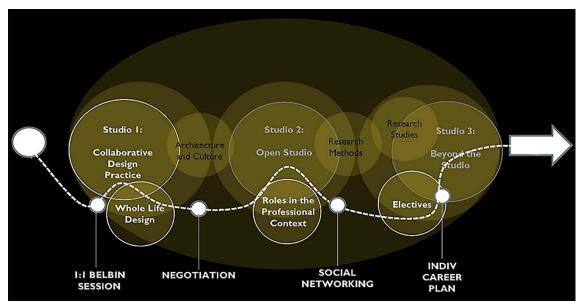
Fig 1. Master of Architecture Programme Professional Journey Dublin School of Architecture, TU Dublin (formerly DIT) J.E. Boyer, K. Donovan, 2019.

Studio Set Up

Prior to formalising the studio the student cohort is analysed using a behavioural test known as the Belbin Self-Perception Inventory. Though the test is used to determine a preference for nine team roles it is used here to ensure a diversity of personalities across each of the student teams. Rather than selecting the natural leader and distributing the team according to perceived strengths, a method no better than picking school yard football teams, we have been keen to ensure that leadership is a role that everyone can partake and make a meaningful contribution. The model we have chosen apply in the studio has been modelled on that coined by Robert Greenleaf in 1977, called *Servant Leadership*.

'Servant style is a model 'where the moral virtue of humility co-exists with action-driven behaviour''. (Sousa & van Dierendonck, 2015, p. 13)

Leadership

Servant leadership recognises that there is no one best way. By rotating the leadership role in each of the teams we have utilised the three dimensions of servant leadership, Sousa & van Dierendonck, (2015); *1) Empowerment – the encouragement of autonomous decision making*, especially accountable informed and responsible decisions, *2) Accountability – providing direction while conscious of individual capability, needs and contribution and 3) Stewardship – concerning the common good.*

Decision Processes

Leadership drowns in indecision. Therefore the decision-making process utilises a wide array of processes, from decision trees, value matrices, cost benefit analysis and audited calculations to provide a system of footholds to allow progress to be made. The seven main aspects of the decision making process are;

Establishing a Positive Decision-Making Environment

A no bias and no blame culture is encouraged in the studio environment in order to free the design process from as much distortion as possible. Social and cultural distortions are inevitable and we recognise that in architecture many decisions are already bracketed by context. Awareness of this conditioning effect is bought to the attention of the students at the earliest opportunity. This framing, while inevitable may be insurmountable, should never be discounted as being harmless.

Generating Potential Solutions

For architecture students, generating potential design solutions is never a problem, though calibrating solutions without support can be challenging. Instead the student is encouraged to think in terms of prototypes, as answers to questions. This moves the student away from a 'solution first' bias to a 'question first' scenario.

Evaluating Alternatives

Evaluating alternatives may include auditing embodied carbon or energy, establishing material limitations, or service life provisions. For example cost benefit analysis as a defined methodology is a designated activity in Phase D. The studio does not employ a fixed methodology. As an open ended process it must respond to the context of the 'wicked problem' set in each particular year. It is more important that the student is exposed to a number of alternatives that they can invoke in future projects.

Deciding

Without some target for results deciding can be difficult in an open-ended process. Instead the student, mainly due to time constraints, are encouraged to live with their decisions which forces them to monitor how the result becomes the contingent basis for future decisions.
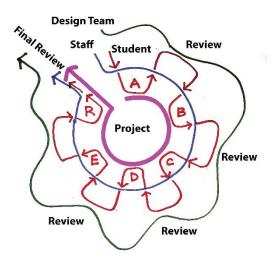
Checking the Decision

Checks and balances, see below, are an integral part of decision-making processes throughout life, but typically in architecture studios the tendency is to either gloss over key data or worse default to aesthetic critique while ignoring uncomfortable truths. The Collaborative Design Studio process therefore concentrates a lot of energy on reasoned defence, ensuring the data is truthful and testable.

Communicating and Implementing

At the end of each phase each team is obligated to summarise, and communicate succinctly their investigations, findings and decisions which will be the contingent foundation for the next phase.

Checks and Balances

An important part of the checks and balances is using a real life project as a measure against their work. A critical feature of the studio is the involvement of the original design team for the source project. This provides a real simulation of the complex nature of the wicked problem. The tacit knowledge built up by the design team over the course of the project also cuts to the critical data that the student requires for their decisions.
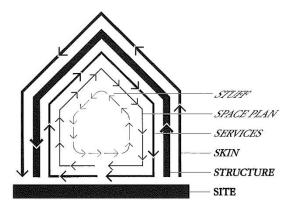
Fig 2. Collaborative Design Studio Interwoven cognitive structure. N Brady, E Geoghegan, 2021,

Fig 3. Shearing Layers is a concept developed by Frank Duffy (1992) which had four layers. Duffy argued that there isn't any such thing as a building but layers of components of differing longevity. Stuart Brand in How Building Learn (1994) expanded the concept to six layers.

Structured learning – Cognitive Scaffolding

The traditional nature of the design pedagogy tends toward an open framework. A heavily structured approach suggests a narrowing of perspective, of options, but we shall demonstrate that the output is both deep and wide in its execution. The student is provided with a supporting theory module, Whole Life Design which supplies parallel and sequential learning and builds the students' knowledge of the critical theories and tools around design durability. We have structured the project around the critical stages in a building design, a type of deconstructed process. Utilising a cognitive scaffold complex themes are introduced for investigation and enquiry. This facilitates a structured and hierarchical decision-making process that enables a narrow but deep interrogation of the topics. As Wood, et al., (1976) suggest, cognitive scaffolding along with active tutorial inputs restrict the range of enquiry in order to facilitate the student's adoption of complex tasks. The six stages of the scaffolding process outlined by Wood et al (1976) are useful ways to think about how we have developed the module.

1. **Recruitment**; see above for notes on the Belbin process (leadership).
2. **Reduction in degrees of Freedom**; limits the range of material presented to the student that can be usefully and comfortably interrogated within the timeframe.
3. **Direction maintenance**; the rotating team leadership position provides a growth opportunity to develop skills such as negotiation, direction, discipline, and support. This enables a mode of self-actualisation which is brought out in the student's reflection.
4. **Marking Critical Features**; is an ongoing tutor led process whereby the work is reviewed and key learning opportunities identified or calibrated based on the student's response.
5. **Frustration Control**; requires careful monitoring by the tutor to avoid becoming too integrated with the student work, avoiding direction but equally encouraging and pushing at key pivot points in the process.
6. **Demonstration**; is a necessary audible, written and visual proof of learning.

As the work is open ended a key feature of the experience is the use of prototypes, to answer questions, small models, simulacra, sketches, computerised simulations, data tables, analytical

calculations, are all necessary elements of the module, not as some definitive final answer but as a basis for assessing the interrelationships of the dynamic system.

The module has now been delivered in two academic sessions and in this short timescale we have found that the cognitive scaffold delivers measurable results with more defined outcomes and better student engagement.

'Research into cognitive scaffolding (Wood et al. 1976) and procedural facilitation (Bereiter and Scardamalia 1987) has indicated that, when provided with external, supporting tools, structures, and real-time guidance, students can be helped to succeed in cognitive processes that are otherwise impossible.' (Kangas, , et al., 2013, p. 163)

Phases

The cognitive scaffold mirrors in part the shearing layers concept that was originated by Frank Duffy (1992) and expanded by Brand (1994). In each phase the critical axes of theory and practice are interrogated. An important part of this enquiry is the role the external consultants play shadowing the process, see below.

Phase	Context	Specific Focus	Carbon & Energy	Tools & Methods
A - Spatial	Environment Contingent Context Urbanism Use Distribution	Typology of Uses		Brief Analysis and Formulation Spatial Design Development Technical Design Development Regulatory Audit Surveys, Interviews
B – Structure		Strategy	Embodied Carbon Embodied Energy	Structures and Frameworks Models – digital and physical
C – Services		Practice	Operational Energy	Systems and Technologies (including Renewable Systems) Research
D – Durability & Cost Benefit		Technique & Comparative Analysis	Embodied Carbon Embodied Energy	Value Engineering - Cost Analysis Prototyping
E – Change Order		Testing	Embodied Carbon Embodied Energy Operational Energy	

Table 1. Phase Matrix with area of focus, tools & methods. N Brady, E Geoghegan, 2021.

Phase A; focuses on the main typological conditions of the project and the relative distribution of space according to environmental and social priorities. Students engage with the immediate context of the project site and attempt to understand the different 'values' associated with the existing site or building, its contingencies and possibilities.

Phase	Critical Questions	
A - Spatial	Typology	The history and context of type, its emergent conditions and how to interrogate these.
	Efficiency	Efficiency planning, effective use of resources, nothing wasted, relationship to type.
	Resilience	Maximising alternatives with minimum means
	2 & 3D solutions	Exploring the 3 dimensional aspect for efficiency, stacking, loading and organisation.
	Contingent Concerns	Sweating the asset, understanding the value of conservation, repair, renewal or replacement.
	Environmental	The impact of context on the deployment of space, light and ventilation.

Table 2. Phase A Spatial N Brady, E Geoghegan, 2021.

Phase B; concentrates on how a building structure can be deployed to deliver on the spatial strategy. An important part of this process is the assessment of the embodied carbon and energy of proposed structural solutions. As decisions on the design of the structure have a large bearing on the building's ultimate usefulness and longevity the students are encouraged to critically assess the efficacy of their proposed solutions.

Phase	Critical Questions	
B - Structural	Typology	Types of structural approaches, emergence of commensurate structural strategies contingent on use types.
	Efficiency	Material efficiency
	Durability	Fire safety and maintenance issues
	Cost Benefit	Alternative consideration, material substitution
	Embedded Energy	Material and transportation costs
	Embodied Carbon	Material costs

Table 3. Phase B Structure N Brady, E Geoghegan, 2021.

Phase C; is the most practice led phase. It is where the design team has a considerable impact in communicating the pragmatics that dominate the deployment of critical building and engineering services and the various choices available in particular in regard to operational energy. Louis Kahn's servant spaces is invoked as a way of thinking about honouring the space needed for an ever increasing and complex network of energy, fluid and communication systems in our buildings today. To paraphrase Kahn, because we have a complete disregard for what are now essential for our comfort, they have to 'given their place'.[4]

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[4] Louis I. Kahn in World Architecture, 1964

Phase	Critical Questions	
C - Services	Typology	Practice based realities
	Efficiency	Core and branch distribution
	Durability	Service Life and Replacement strategies
	Operational Energy	Cost of Energy

Table 4. Phase C Services N Brady, E Geoghegan, 2021

Phase D; covers the specifics of building. The nature of the studio emphasises the discrete nature of the shearing layer concept and how this can be translated into an architectural design response. The student is also introduced to the driving concept of whole Life Building with a view towards longevity of components and materials and where necessary to repair, renew or replace that these are easily disassembled and reassembled. This has relevance to end of life preparations and for material reuse. Inevitably cost benefit analyses come to the fore, where the student is asked to run through scenarios to test their assumptions. These micro design exercises allow detailed examinations while quantifying the global implications.

Phase	Critical Questions	
D - Durability and Cost Benefit Analysis	Durability	Service Life and Replacement strategies
	Assembly	Detailing Strategies (for repair, renewal and replacement)
	Resilience	Multimodal architecture
	Material	Durability and Quality
	Aesthetics	The architecture of durability and flexibility
	Cost Benefit	Assessing value for money exercise (invest for the long road)

Table 5. Phase D Durability and Cost Benefit Analysis N Brady, E Geoghegan, 2021

Phase E; is a novel strategy which inverts the studio problem. By removing what was previously the contingent reality, the student is challenged to verify the resilient nature of the project they have now designed. Though the change order is designed to be sympathetic to the original wicked problem, it does offer significant challenges of its own.

Phase	Critical Questions	
E - Change order	Test	Can an alteration in the context validate or invalidate the decisions already taken, what elements are robust to such scrutiny and what ones have to be re-thought.

Table 6. Phase E Change Order N Brady, E Geoghegan, 2021

Role of Design Team

An important and central pillar of this studio is the active engagement of a professional design team that offer critique, advice and support for the student work. The situational aspect of the wicked problem is an essential root to the studio. Embedding the original design team in the

theoretical studio grounds the design activity, brings a realism to the studio and imparts a wealth of tacit knowledge to the students. As the work progresses the professional team moves from sharing to motivating and propelling behaviour as it underpins each of the student group's speculative and reasoned presentations. As a result of COVID-19 restrictions (2020-2021) this engagement moved to a remote working platform.[5] This move had a surprising benefit compared to our first iteration in the previous academic session. Due to professional challenges the synchronising of external consultants can be problematic. In this iteration the sessions could be pre-scheduled and locked at the start of the semester which delivered more predictable and guaranteed engagements. **Conclusion**

Despite developing this module in a theoretical vacuum, it has been the culmination of years of pragmatic design teaching experience. We have found areas of overlap with analytical and theoretical work in the areas of Pedagogy, Business Organisation and Cognitive Psychology. In this paper we recognise parallels to Roth & Kleiner's (1998) Learning History mode of organisational interrogation.

Critical Elements of Learning History (Roth & Kleiner, 1998, p. 55)	**Collaborative Studio** (Brady & Geoghegan, 2021)
The collaboration of company insiders and outsiders.	Holistic non-judgemental or biased collaboration, use of empirical reasoning.
Beginning with noticeable results.	Work based on measurable and real data from the studio.
The use of the jointly told tale.	The collective presentation and reasoned aggregation of ideas.

Table 7. Application of Learning History Methodology

Roth & Kleiner's (1998) methodology is a useful scaffold to compare the processes involved in this studio. It illustrates the value of parallel methodologies which are fundamentally targeted at the same objective, (quality of thinking and action in organisations), and can be useful in framing the wicked problem of human interaction and value judgements. Firstly the student is encouraged to capture their learning in a diary of engagement, mapping their role and response to the various challenges. This feeds back into their group activities and together they form a collective body of knowledge. And in this paper we stretch the framework to help convey our own post rationalised assessment of this new mode of teaching.

Planning; in our scenario we have engaged a professional design team, as effective champions that guide and act as a sounding board to temper the student work. In the original iteration it was envisaged that we could use an avatar. However this version has proven invaluable and despite the Covid-19 restrictions we have found the integration of the external advisors more consistent.

Reflective Interviews; the studio is operated on a complete open and transparent basis, with no limits or aesthetic bias. In this case discussions, interviews and coaching takes place on a near constant basis, supporting, interrogating and challenging ideas. To enable these processes, a great deal of attention is applied to the use of prototypes as answers to questions.

Distillation; Students are encouraged to conduct a wide enquiry at the start of each phase and by eliminating variables encouraged to distil solutions, rather than invent them. This grounding

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[5] The studio utilised MS Teams as the main virtual platform to facilitate remote working by team members and inputs from the widely distributed professional team and studio advisors.

is a necessary foundation piece for each stage of the project. Whereas Roth & Kleiner (1998) use this part of the methodology to refine the basis of storytelling 'rooted in the data' (Research), telling a 'compelling archetypal story' (Mythic) but retaining an easily read, heard and discussed story (Pragmatic) we can see how this is mapped back onto the studio work, where the work is founded on research, is conveyed in a compelling design (a plausible fiction) and communicated in pragmatic terms.

Writing; to this we add the act or presentation which combined with a convincing argument must be able to communicate to a broad audience, 'valid and representative, yet succinct and direct' (Roth & Kleiner, 1998, p. 55)

Validation; is an essential aspect of this process and the work is subject to various types of audit, form data analysis to design team assessment. The constant iteration means that the work is under constant review, developing and progressing.

Dissemination; of the final report and presentations are encouraged to be open ended, not a finish line. Unlike other studios which emphasises completeness, we recognise the openness of the process. As information changes, as the contingent is varied the approach must adjust if the result is to be meaningful. As Roth & Kleiner (1998) identify the final manuscript is for discussion, not a report.

The studio cumulatively builds towards an aggregated series of lessons and skills which are gathered together in a final collective presentation and individual reflection on the student's own journey. It is hoped that the lessons learned will feed back into a cybernetic[6] understanding of architectural education and practice. This has significant implications for other multidisciplinary areas, including business development. The evidence in the studio suggests that Architectural Education can provide an expanded range of skills that are increasingly important requirement in a less predictable future. As a model of cognitive scaffolding it suggests a methodology that may assist other disciplines especially in the development of multi-disciplinary teams. Moreover it provides some evidence of the value of servant leadership as a model for developing responsible decision making.

'Cost Benefit Analysis proved to be an excellent learning mechanism and the definition of a wicked problem, and although our decisions of material were not always the cheapest, our commitment for Durability and Sustainability of the building's whole lifetime caused us to lean on the side of Qualitative design decisions over Quantitative.' Student A

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[6] Cybernetics is concerned with circular causality and feedback, especially in regard to performance related activities especially those in environmental, cognatic and social systems.

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