Architectures of Consequence: A Methodology for 'Live' Building Performance Evaluation in the Studio

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Introduction

Architectural education typically prepares students to be able to design new buildings or alter existing ones, and possibly to be able to predict their performance through modelling. What it does not do yet, is teach them how to evaluate the actual physical and experiential performance of buildings in reality. There is no requirement to do so for RIBA validation, despite the huge gap between predicted and real performance in buildings around the world. It is vital that students are equipped to understand how to carry out these types of evaluations, both in relation to their own design work and that of others, and how they can feed these back into their own design work and produce architectures of consequence.

This paper sets out an initial theoretical and ethical framework for 'Live' Building Performance Evaluation. It then assesses the different methods that are currently available for fitness of purpose in an educational setting and introduces new individual and collective evaluation methods. Finally it explores the barriers and opportunities for staff and students wishing to evaluate building performance at all stages in the current architectural studio in the UK and beyond. It aims to help answer the question: '*How can we best introduce building performance evaluation into the architectural curriculum*?'

Theorising 'Live' Builiding Performance Evaluation

Building Performance Evaluation (BPE) is a heavily contested and rapidly evolving field of research enquiry. It differs significantly from traditional Post-Occupancy Evaluation, first developed in the 1960's and 70's in the USA and UK, by concentrating on the *complete* building process to ensure that '..research, measurement, comparison, evaluation and feedback… take place through every phase of a building's lifecycle..'[1]

'Live' is equally contested territory in relation to architectural pedagogy, particularly in relation to the definition. Most would accept that the term embodies a connotation of social inquiry and service in relation to a real 'client'[2], but beyond this there is no agreement as to whether a 'Live' project is simply propositional (feasibility studies), or the degree to which end users are involved and whether or not a public artifact (report, exhibition, building etc.) should be produced. For the purposes of this paper, a 'live' BPE study is taken to mean the provision of a social intervention through architectural pedagogy that will benefit end users in relation to a project developed with a particular client or client group who could not otherwise undertake the work themselves.

What makes BPE 'live' then? The interrelationship of four socio-technical theories provides a helpful framework: Phenomenology, Critical Realism, Social Learning and Social Practices. Each theory adds a different dimension to ensure that, as far as possible, a more complete and dynamic 'live' account of BPE can be made.

BPE is fundamentally a phenomenological undertaking, evolving out of work by Zeisel[3] which developed tools for researchers and students to study how people behave in a particular environment, what physical traces they leave and what their unique perceptions are. On its own, Phenomenology is as agnostic as Constructivism is in terms of power and social relations in the built environment (how much control do you have over your environment and why is that?). Equally, it is very difficult to develop a useful predictive model for BPE from these theories alone. Scientific Realism, typically found in many methods associated with physical measurements of building environments, has its place in BPE, but its 'objectivity' can be questionable in relation to the measurement parameters adopted by those in power and the subsequent effect on end users. This is where Bhaskar's critical approach to realism[4] can help to ensure that all BPE parameters are examined and developed with a healthy skepticism and awareness of the social context in which BPE is conducted.

Recent research has acknowledged the pivotal role that Schatzki's Social Practices theory plays in BPE in terms of the need to incorporate end user know-how, habits and practices into BPE[5]. Many previous BPE studies failed to acknowledge this aspect, relying on qualitative surveys and interviews merely to establish perceptions without significantly interrogating the connections between bundled know-how, habits, practices and how these frame building performance. A further development from the individualized approach of Social Practice evaluation is the use of Social Learning theory to demonstrate how BPE can help develop collective learning in housing developments[6]. By combining Social Practice and Social Learning theory in BPE, the element

of 'liveness' can be increased as student BPE projects can become more action-research orientated and provide more meaningful and effective interventions which 'stick'.

Why Should Architectural Students do BPE?

The two other papers in this conference symposium covering student BPE projects by Sharpe and Gupta respectively describe a domestic case study and a methodological approach for students to be able to carry out post-occupancy evaluation studies more generally. Both papers describe a variety of good practical and experiential reasons why BPE should under taken by students. These can be summed up as a means of grounding student design approaches in reality and giving them the experience and tools to be able to do so. At the same time both papers highlight how BPE can help to reduce the performance gap between predicted and real comfort and energy use in buildings, as well as help to improve the use of new technologies.

There are, however, deeper philosophical and ethical reasons for why students should be required to undertake BPE studies in Schools of Architecture. Architects have a professional 'duty of care', very much like the doctor's Hippocratic Oath, to do least harm to the planet during the course of their activities. The most recent Royal Institute of British Architects (RIBA) Plan of Work published in 2013, recognizes this and highlights the need for post-occupancy evaluation (POE) and a 'Soft Landings' process which incorporates (POE) findings directly into both current and future design activities. A 'Soft Landings' approach will be a UK government requirement for all government procured buildings from 2016 onwards. It is also anticipated that some form of POE will be built into the next set of UK building regulations.

One criteria that sets the professional architect apart from a builder, is the requirement to balance immediate business needs with the wider good. And yet, as Bordass and Leaman rightly highlight: ' Accountability is replacing trust, reflecting what is happening in wider society – the unintended consequences of replacing ethics by rules and regulations, and leaving everything else to the invisible hand of the free market.'[7] An ethical approach to architecture, which can gain social consent, demands a secure connection between research, practice and education. This in turn means that BPE studies cannot be carried out in isolation in Schools of Architecture – they have to be directly linked in some way to the design studio, if they are to gain an ethical purchase within the student's (and architects) design process.

At What Studio Stage can we Introduce 'Live' BPE?

Existing methods for student POE and BPE studies have been described by Sharpe and Gupta elsewhere in these conference proceedings, including the notion of a 'light touch version' of POE technology teaching in order to make it more mainstream. This would focus on an energy assessment, walk-around survey and occupant feedback survey of existing buildings. The question remains – how can we incorporate BPE methods directly into studio teaching most effectively?

Clearly some BPE techniques and methods are easier to teach at Undergraduate level – these include observational studies, simple spot measurements of environmental conditions, interviews, and questionnaires (Fig.1). These can be carried out alongside a literature review of existing BPE studies related to the design typology being developed in the studio project.

Fig.1 Students can carry out simple observation work (photo: Gloria Vargas)

Where students are working with existing buildings, these methods can be used directly to help inform their individual design responses, and by Year 3 can help students to refine their own design briefs. Where they are designing new buildings from scratch, these BPE methods can be usefully transferred to context analysis alongside reading relevant BPE case studies to raise awareness of critical performance issues for the typology. This takes the notion of 'precedent study' to a deeper, more informative level, and teaching needs to be formalised here as part of the 'precedent analysis' if the BPE studies are to be effective.

Other BPE methods, such as detailed working drawing and specification analysis, thermal imaging, energy audits and assessments, monitoring, benchmarking, combined with modelling, may be more suited to M.Arch or Postgraduate level design studio which directly combines initial BPE studies with a studio design project involving existing buildings. Where the studio is concerned with a new building, then a seperate POE case study on a similar type of existing building should

be undertaken ahead of the studio, as described by Gupta. The studio timetable is critical – it is vital that the BPE studies are always carried out ahead of the concept design stage to ensure that strategic decisions are informed by the findings. This process is most suitable either for year long thesis projects in M.Arch, or where a design project is only one semester long.

New Methods of 'Live' BPE

Several new BPE research methods have been developed by the author, in collaboration with others, which may help to further address the need for studio-related BPE studies particularly in relation to 'live' design projects which include adaptation and/or extension of existing buildings.

Usability studies

Formal ergonomic studies traditionally take place in the first year of architectural education to help familarise students with basic functional requirements for designing spaces and products in a user centric manner. BPE provides an additional opportunity to evaluate existing relationships between various environmental 'touch points' that users typically come into contact with via their senses in relation to each and every design project a student undertakes to help reinforce the initial ergonomic learning. Without this reinforcement, students (and subsequently architects) quickly forget these requirements, because they are not embedded.

A simple analysis of six key factors (Fig. 2) in relation to key user functions such as opening doors, windows, using kitchens, bathrooms, maintenance of the exterior etc., carried out as a formal exercise on a detail design proposal can help a student to understand whether or not their building is really usable.

Usability criteria	Poor				Excellent
Clarity of purpose					
Intuitive switching					
Labelling and annotation					
Ease of use					
Indication of system response					
Degree of fine control					

Fig. 2 Usability criteria and ranking scale

Ideally, the analysis should be carried out by an end user and discussed together. The bath below illustrates the typical problem which can arise (Fig.3) if space is too small.

Videoing building performance

A key aspect of good design relates to the temporal relationship between user practices and the building.

Fig.3 The usability of this small bath is questionable.

Frequently students undertake BPE or other precedent case studies with reference to drawings, photographs and specifications only. The use of simple short videos to analyse how people interact with buildings as a process can be very revealing to students in terms of understanding why buildings work the way they do, particularly when combined with short interviews with those being videoed. This technique was pioneered in domestic BPE research by the author[8] and was subsequently been adopted by the UK Technology Strategy Board as part of its Building Performance Evaluation programme (2010-14). A classic finding in one new low carbon home revealed that users could not use an entrance lobby effectively because of the door sequence in relation to the storage area. As with all user information, any videoing requires ethical approval in advance from the users. Most Universities have a formal ethics procedure for student projects which accommodates these type of requirements. Time should be allowed for accommodating this process in advance of starting any BPE study.

Social Learning in the studio

Social Learning theory examines how people can learn together how to do things through the social organisation of individual interactions. In BPE, this is now being used to understand how people living together help eachother (or not!) to use their new low carbon homes or retroffited homes. It is also being used to understand how people learn together how to use their work environments. In the architecture studio, peer learning is highly effective when the studio is organised both physically and socially to facilitate this. Carrying out BPE studies in small groups of 3-5 students is generally much more effective than individual assignments. The number is small enough to ensure that individual activities can be cross-referred to easily through group discussion with significant peer learning opportunities.

Two classic examples of extended Social Learning through studio design and BPE studies are the 'Ecomod'

project developed by John Quale with his architecture students in the University of Virginia, USA and the 'The Saint Gobain Nottingham H.O.U.S.E ' developed by a variety of staff with students at the Department of Architecture in the University of Nottingham. In the ongoing 'Ecomod' project, students work with clients and academics to design low cost houses and subsequently go on to build them on site under the supervision of a contract manager. What is particularly impressive about this 'live' project is that BPE is built in from the beginning and each new home designed and built benefits from the BPE findings and lessons from the previous home (Fig 4) .

Fig.4 A typical Ecomod house built and monitored by students

In the 'The Saint Gobain Nottingham H.O.U.S.E ' built for the European Solar Decathalon competition in 2010, students were required to model the predicted performance. Subsequently, PhD students inhabited the home and carried out extensive BPE studies on it. Both of these projects required exceptional commitment from both staff and students over a two year period, as well as substantial sponsorship, and it is not anticipated that every School of Architecture can undertake this type of project each year. However, they act as beacons for what can be done in terms of linking 'live' studio projects with BPE and can hopefully inspire other studios to consider BPE studies as an inherent part of their smalle 'live' projects.

Blogging and 'Pinterest'

Digital technology means that it is now easier than ever for students to keep BPE diaries in the form of online blogs linked to School websites that describe what they are doing and what they are finding out. This is a particularly powerful way of disseminating early studio BPE work when working on a 'live' project, but care is needed in relation to ethics and agreements with the end users about who can see the information. Creating 'Boards' on the digital site 'Pinterest' is visual way of recording images and data that is particularly useful for architecture students who want to share and build their BPE information with others – it can be restricted just to the working group, studio, year or opened up to the public. Inspirations and ideas can be shared using 'Pins' that make links from one site to another.

Barriers and Opportunities for BPE in the Studio

There are numerous barriers currently preventing a wider uptake of BPE studies in Schools of Architecture. At present neither the EU, ARB or RIBA Validation procedures for architectural education require any form of building performance pedagogy, beyond the predictive stage. Why is this? Typically, in the past, BPE has been viewed with suspicion by designers and clients concerned with potential outcomes leading to litigation. As BPE has become more accepted, the issue of cost is still a thorny one – who will pay for BPE? Often, the client expects the architect to pay, while the architect expects the client to pay. There is no clear way forward at the moment, although it is clearly in the client's interest to discover whether or not the building they have bought actually works. There is also a catch up game going on, given that it is only very recently that the RIBA has endorsed BPE in its Plan of Work for architects and the RIBA Validation Criteria themselves are not due for revision for a couple of years at least.

Another uncertainty arises when future end users may have different values to those end users or client working with the architecture students on their BPE studies (this can be particularly acute in relation to housing) or when end users have different value systems to the architecture students themselves. Both of these issues need careful consideration when defining the parameters of any BPE study.

Some would also argue that BPE is too difficult to accommodate within the architectural curriculum, but the various examples and methods above demonstrate that it is possible to do BPE studies in a variety of ways that suit the different stages of architectural education. Further barriers occur because BPE requires an interdisciplinary approach, combining quantitative and qualitative methods with a sound understanding of building physics – something which is taught less and less in Schools of Architecture, and which in practice has been handed over to the discipline of engineering. There is also the mistaken perception among some studio staff that BPE studies are an 'addition' to design work and form part of the curriculum creep that threatens to overwhelm studio design time.

Well conducted BPE is actually a component of design analysis and should be viewed as inherent part of the design process. A number of Schools are now successfully combining technology teaching with studio design work, using case study evaluation and individual BPE methods – it is only a small jump from these approaches to using a more integrated and holistic approach to BPE as part of the design studio which involves a number of methods.

There are also major opportunities for introducing BPE studies in relation to 'live' projects which offer a means to work with real end users. Imagination is needed to stretch the evaluation of these projects over a longer period of time for a more effective outcome and this may involve different groups of students undertaking the BPE studies, or the same group of students undertaking the BPE studies the following year. Equally the increasing emphasis on retrofit and the re-use of existing buildings in architecture as part of the drive towards greater sustainability, resilience and climate mitigation/adaptation, provides improved opportunities for students to experience BPE studies first hand using real buildings and end users. Finally, the increasing emphasis on interdisciplinarity in higher education and the notions of co-production and university engagement all bode well for BPE studies which fundamentally require participation with end users and preferably other disciplines to help ensure that architectural education delivers a holistic user-centric approach to design.

Conclusions

This paper has attempted to briefly sketch out a theoretical basis for 'live' BPE studies in architectural education, examining existing and new BPE methods and examples as well as highlighting key barriers and opportunities for the development of BPE pedagogy.

More research is required to identify exactly what impact incorporating BPE into design studio pedagogy actually has on students developing a suitable understanding, ethics, values and skills base in relation to designing 'good' buildings which are user-centric, resilient and sustainable. Testimony from student feedback on Gupta's POE module suggests that they find it incredibly useful in relation to their design work, but it would be helpful to be able to tease out which aspects are seen as most helpful.

What is clear, though, is that architecture needs good feedback on design if it is to be consequential, and BPE is potentially able to fulfill that role. If Schools of Architecture do not take up the opportunity to teach this to their students, the role will simply fall to other disciplines, and architects will be on the margins, with a lost opportunity. A rigorous debate on values and methods is needed now to ensure that 'live' BPE student projects address *all* relevant criteria in architecture and not just the socio-technical ones. This in turn will help to ensure that sound feedback becomes routine in architectural practice rather than a rare event.

References

[1] Mallory Hill, Shauna, Preiser, Wolfgang F.E, and Watson, Chris. eds. *Enhancing Building Performance*, Blackwell Publishing Ltd: West Sussex, UK .2012. p3.

[2] Butterworth, Carolyn. *A Handbook for Live Projects: Sheffield School of Architecture*. The University of Sheffield. 2013 p5.

[3] Zeisel, John. *Inquiry by Design: tools for environment-behaviour research*. Brookes-Cole, Wadsworth, Inc.: Monterey, CA. 1981.

[4] Archer, Margaret et al. eds. *Critical Realism: Essential Readings*. Routledge: New York. 1998.

[5] Vlasova, Liodmila and Gram-Hanssen, Kirsten. "Incorporating inhabitants everyday practices into domestic retrofits". *Building Research and Information* . 2014.42 (4) p 512-524.

[6] Baborska-Narozny, Magadelena. and Stevenson, Fionn. "A Social Learning Tool – barriers and opportunities for collective occupant learning in low carbon housing" in *Proceedings of Sustainability in Energy and Buildings 2014*, SEB-14, Cardiff, UK 25-27 July 2014

[7] Bordass, Bill and Leaman, Adrian. "A new professionalism: remedy or fantasy?" *Building Research and Information. 2013.* 41 (1) p 4.

[8] Stevenson, Fionn.,and Rijal, Hom.B." Developing occupancy feedback from a prototype to improve housing production". *Building Research and Information*.2010. 38 (5) p 549-563.