# Towards an energy 'literate' architecture graduate? UK educators' and students' evaluation

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## Abstract

Whilst calls for upskilling and retraining the UK construction workforce to meet increasingly stringent energy targets are repeatedly documented in construction strategy and policy reports, it remains unclear how higher education, particularly architecture, is responding. The purpose of this paper is to examine how educators and students across UK architecture institutions view energy related content in their teaching and learning, and how some of the policy initiatives are being approached. The analysis focuses on what educators and students perceive is being taught and how they evaluate issues that need to be 'upskilled' or 'retrained'. This study draws on evaluative practice literature using multiple data sources including focus groups across UK accredited architecture institutions. The research identifies evaluative perspectives that educators and students draw on to discuss views such as personal interests, institutional sovereignty, experience, physical and disciplinary disconnects and an expectation that 'something will change'. Transforming the status quo is perceived as a major obstacle whereby a school design agenda, design studio educators' motivations and a curriculum that only gets added to are shared concerns. The findings enable foundational discussions that will help define recommendations of required educational approaches to 'upskilling' and 'retraining' in a fast-developing international energy policy agenda.

**Keywords: architecture, building performance, energy, evaluation, higher education, sustainability**

## Introduction

Recent UK construction policy and practice literature emphasise the need for upskilling and retraining of architects to meet increasingly challenging energy performance standards. UK governmental and policy reports highlight the need for a skilled and 'energy literate' construction industry. The 2011 UK HM Government report on "Skills for a Green Economy" outlines the need for diverse sectors to provide recommendations for required strategic skills to 'enable a transition to a sustainable low carbon economy' (HM Government 2011). The UK Zero Carbon Hub End of Term report issued in 2014 emphasizes the need for retraining across the built environment professions suggesting there is an apparent shortage of skills and knowledge amongst design professions particularly architects on issues such as energy performance (Zero Carbon Hub 2014). More recently, the UK Construction Strategy

2016-2020 continues to call upon the need for upskilling and retraining to meet the needs of a low carbon economy (HM Government 2016). Outside the UK, in the USA there have been calls on the architecture profession to promote greater energy analysis in their design practice (AIA 2012).

In most policy initiatives, reports or strategies the focus has been on the profession and professional development with emphasis placed on those working in the industry. Higher education, future graduates and the teaching profession are largely overlooked. In addition, few empirical or theoretical studies have examined how higher education has approached the issue of 'energy upskilling' or addressed the calls for retraining. Whilst the built environment higher education sector is tasked with equipping future graduates with the required skills and competencies, educational research has focused little attention on examining how energy related content is being taught, learnt and assessed across the built environment and especially in architecture curricula.

Exceptions include recent work in other education settings by De Waters and Powers (2011; 2013) whose work defines energy literacy measures in secondary school settings in the US. The survey devised by De Waters and Powers (2011) has recently been applied in a sample of 2400 secondary students involved in a national energy education program in Taiwan by Lee *et al.* (2014) showing potential wider applicability. Similarly Cotton *et al.* (2015) carried out a large survey utilising a sample of 1100 university students emphasising the need to enhance knowledge on energy saving measures as a way of improving informed decision making.

The purpose of this paper though is not to measure energy literacy in architecture education, characterised by iterative design studio methods of learning and therefore ill suited to quantitative survey style evaluation. Instead the aim is to understand how UK architecture educators and students account for energy content in their practice to reflect upon their evaluation of teaching, learning and assessment approaches. Through discussing some of the approaches across UK architecture institutions, this study might help initiate a broader conversation on the shaping of energy education in the built environment. The following sections discuss relevant literatures on energy policy in the UK built environment context as well as architecture education and energy. Following on the research method is outlined, followed by the findings section, discussion and conclusion.

***Policy background on construction and energy in the UK built environment context***

Prior to the 2002 Energy White Paper 'Our Energy Future - creating a low carbon economy' (DTI 2003), UK's principle approach to policy and legislation of energy in construction had been mainly set out by building control supplemented by voluntary certification tools such as BREEAM and Eco Homes (later known as Code for Sustainable homes). In the European context during the mid 2000s there was increasing awareness of the impact the built environment had on carbon emissions as evidenced in the 2006 European Energy Efficiency Action Plan (CEC 2006). In the UK during the same year, there was the ability to consider grants for microgeneration via the Low Carbon Buildings Programme, all set in the context of the Climate Change and Sustainable Energy Act (DECC 2006). The 2008 Climate Change Act followed setting out carbon reduction targets of 80% by 2050.

Since the late 2000s there were increasing measures, regulations and energy policy initiatives to reduce carbon emissions in the UK. Policy and industry initiatives included the 2016 Task Force and a UK Green Building Council founded in 2007, to be followed later by the Zero Carbon Hub in 2008. The Zero Carbon Hub's primary purpose was to enable guidance and recommendations on how zero-carbon building could be achieved. Whilst the Carbon Reduction Commitment in 2010 set out energy efficiency improvements, the most significant and consistent policy package in the UK was generated in Europe including two Directives: 2010 Energy Performance of Building Directive (EPBD, Directive 2010/31/EU)) and the 2012 Energy Efficiency Directive (EDD, Directive 2012/27/EU).

The 2010 Energy Performance of Building Directive policy (EC 2010) steers the built environment towards more ambitious energy standards and increased use of renewables. The required Energy Performance Certificates play a key role as they inform the buyer or tenant of the energy performance of a building. The policy also establishes a minimum Energy Efficiency Standard (MEES) for the private rented sector, and the display of these in public buildings. The 2012 Energy Efficiency Directive (EDD, Directive 2012/27/EU) followed with the purpose of addressing the energy performance of existing buildings. Both policies are due to be changed in 2017 but it remains unclear if the UK will embed these directives into law considering recent Brexit negotiations.

Whilst many other policy packages were introduced in the last seven years, a number were also cancelled, amended and rebranded. The Coalition Government had introduced their

own Energy Act (HM Government 2011) including several measures such as a framework to guide the development of a smart grid; requirements for more information on energy bills; the creation of a Green Investment Bank and the Green Deal, regulatory requirements for zero carbon homes, and a new Energy Company Obligation targeted at vulnerable households. However, the 'Green Deal' scheme, regulatory requirements for zero carbon homes as well as policy initiatives such as the Zero Carbon Hub were cancelled or rebranded in 2015.

Despite a strong shift eight years ago towards a low carbon regulated policy, it has become unclear how energy policy in the built environment will evolve in post Brexit Britain (Chaudry *et al.* 2015). UK professional bodies and universities face an uncertain agenda on how to shape future graduates to meet demands of a low carbon economy. The impact on architecture education is critical, particularly in light of ongoing challenges to build and operate buildings to meet designed energy targets.

### *Architecture education and energy in the built environment*

Architectural education in the UK is monitored and validated by the Royal Institute of British Architects and the Architectural Registration Board (RIBA/ARB)who base criteria for validation and prescription on the requirements of article 46 of the EU Qualifications Directive as well as the Quality Assurance Agency Subject Benchmark Statement (RIBA 2010). Prescription/Validation criteria include specific learning outcomes across a range of built environment concerns. Energy issues are not prominent within descriptions of required graduate attributes, however, broad aspects relating to wider environmental and sustainability issues are included.

Whilst there have been growing discussions in the wider higher education context on measuring and improving energy literacy amongst students, research in the built environment domain has mainly focused on broader aspects related to sustainability pedagogy. Though not specifically discussing energy related content or literacy, the following studies offer valuable insights into related broader sustainability pedagogical concerns. Discussions emphasise two aspects relating to sustainability education: barriers to curriculum integration (Altomonte *et al*. 2012; Cotgrave and Alkhaddar 2006; Rutherford and Wilson 2006) and guidance on how to achieve integration (Alahmad *et al.* 2011; Batterman *et al.* 2011; Murray and Cotgrave 2007). Research that focuses on incorporating sustainability concerns into built environment

education outline limitations and opportunities for successful integration. Pan *et al.* (2012) argue barriers to successful implementation of sustainability concerns are found in conflicting approaches to research versus teaching amongst students, lecturers and the institution.

Cotgrave and Alkhaddar (2006) also outline barriers to achieving environmental literacy in the construction education sector. Limitations are described as being contained within the nature and structure of higher education in the UK in areas such as academic indifference and approaches to teaching, lack of communication between industry and academia and lack of student engagement. Altomonte *et al*. (2012) suggest deficiencies lie at a European level in university architectural education structural curriculum set ups. They explore the outcomes of a European project 'Environmental Design in University Curricula and Architectural Training in Europe (EDUCATE), suggesting barriers to implementing sustainability in architectural education lie in educational policy and organizational barriers at a strategic European level.

A number of scholars have also begun to articulate some of the ways sustainability could be better integrated into curricula as well as the competencies that encompass sustainability literacy in the built environment. Murray and Cotgrave (2007) demonstrate the rationale for systematically embedding sustainability within the construction curriculum to the benefit of professionals, professional bodies and educators. Other scholars look at proposing specific methodologies that integrate real-life projects or energy monitoring systems into curricula. Alahmad *et al*. (2011) propose a variety of methods to integrate sustainability into engineering curricula using the architectural engineering (AE) program at the University of Nebraska–Lincoln (UNL) as a case study.

Hartenberger *et al.* (2013:61) suggest developing shared built environment professional identities for education and training including: "a stronger emphasis on problem-based learning, a more widespread adoption of an apprenticeship model, and inter- and intra-disciplinary learning". Their study suggests the lack of a built environment professional identity prevents a collective whole life-cycle approach from being holistically adopted by all stakeholders. However, few studies have examined empirically or theoretically, how educators in architecture view learning, teaching and assessment on a relevant and important topic such as energy issues in buildings. Although scholarship and policy have stressed the importance of gaining 'literacy' on the topic, discussions have largely overlooked issues with defining and clarifying the attributes that shape energy literacy. Instead, most discussions as

reviewed above highlight barriers to integrating sustainability wide issues or propose methods for implementation.

**Theoretical framing: Evaluative practice**

The broader sociological domain has been interested in evaluation, evaluative understandings and practices for some time. Understanding how educators evaluate teaching and learning is viewed by some scholars as a key way to improve curricula, pedagogical practice and ultimately learning (Pajares 1992); all of which have implications for policy implementation and adoption.

Evaluative understandings and practices are viewed as an important aspect of the knowledge making process in "gatekeeping, filtering and legitimating knowledge" (Camic *et al*. 2011: 209). Evaluative practices are defined as a way of "assessing how an entity attains a certain type of the worth" (Lamont 2012: 5). Evaluative tools are viewed as some of the constraints that shape evaluative practices (Zuckerman 1999). Scholars have considered how evaluation unfolds in different settings and between different disciplines (Lamont 2012). In most studies quantification is viewed as a formalizing of evaluative practices viewing quantifiable measures as an inevitability of evaluation (Wijnberg 2011).

In creative fields where quantifiable evaluation is rarely used, the focus is on peer review, the role of critics and settings such as awards (Lamont 2009; Lamont and Huutoniemi 2011). Whilst awards settings are not empirically relevant to the focus of this study, research carried out in the context of creative settings and awards offer helpful insights into ways evaluation can be examined from a qualitative perspective of specific value in an architecture education empirical setting. Discussions that debate evaluation in awards focus on the differences in evaluative understandings between different disciplines (Lamont and Huutoniemi 2011) as well as the influences and effects on the peer-review process (Mathieu and Bertelsen 2013; Moeran 2012)

Evaluation and its underlying practices are viewed across social sciences as the underlying foundation to social and intellectual activity (Camic *et al.* 2011). Essentialy evaluative practices inform us of how particular views, approaches and commonly accepted standards are constructed and determined (Lamont 2009). The analytical value of the

evaluative practice literature is in exposing influences, context, values and disciplinary views that actors (such as educators and students) draw on to evaluate a particular issue such as energy.

For some scholars, evaluation is about the negotiation of values where value is seen as the "merit of a product in terms of its overall estimation in which it is held" by those who evaluate (Moeran and Garsten 2013: 6). Lamont (2012) indicates evaluative practices can undergo several estimation processes such as: categorization and legitimation. Categorization is mainly seen in terms of determining in which group an entity belongs, wheras legitimation is viewed in recognition by oneself and others of the value of an entity (Lamont 2009). At a minimum evaluative practices are concerned with categorization by determining how entities are classified (Zuckerman 1999). In most domains categorization is determined through quantitative means by classifying, ranking and ordering (Wijnberg 2011).

Lamont (2009) draws attention to the importance of disciplinary differences as an important aspect of evaluative practices in settings where peer-review is central such as architecture and associated design disciplines. Other scholars, however, have suggested that definitions of worth are also context and interaction dependent (Mathieu and Bertelsen 2013; Moeran 2012). Underlying most debates on evaluation is the notion of 'worth'. Moeran and Garsten (2013) discuss worth in terms of the value of a product and in terms of its overall estimation in which it is held by evaluators such as peers in peer-review.

The focus of discussions for scholars engaged with evaluation in creative settings has been primarily on what influences the evaluative process whether disciplinary, contextual or personal and how these influences impact on the outcome. Influences for instance are mainly described as formal and contextual in terms of the evaluators or evaluation process whereas influences can also be emotional and subjective (Lamont 2009).

Contextual influences are described as being determined by the actual setting (Mathieu and Bertelsen 2013). These contextual influences are argued by Mathieu and Bertlesen (2013) to enable and constrain various types of evaluative practices. Formal consequences are described as dependant on the selection of criteria of judgement, while informal dimensions are discussed as perceived expertise, reputation and accomplishments of person evaluating.

## Research methods

The research design is based on narrative enquiry (Ospina *et al.* 2008) drawing on multiple data sources including documentary evidence, observations, semi-structured interviews and focus groups with two participant groups. Data collection commenced in February 2015 and was completed in Dec 2016 with analysis and literature reviews overlapping. Interview and focus groups sessions involved a total of 48 participants in England, Scotland and Wales. Documentary evidence included 32 documents including UK professional body validation criteria reports, undergraduate architecture course programme specifications (see Table 1)

<<Insert Table 1 here>

Semi-structured interviews were carried out with 24 educators across 9 accredited institutions in England, Wales and Scotland (Cases 9,11,12,21,23,24,25,26 and 27). Initially 65 heads of schools and heads of undergraduate programmes were contacted across 43 accredited UK institutions. Initial contact was made with heads of schools who then, typically, suggested participants who lectured in environment and technology led modules and were perceived (by the heads) to have expertise. Although the authors asked to speak to other members of staff irrespective of content taught, in most cases participants taught environment and technology modules. Focus groups were carried out with students in order to help generate collective as well as individual views (Silverman 1997). Authors contacted all the participant schools in order to conduct focus groups with students; however timetabling issues and different approaches to assessment meant there were practical difficulties in arranging participants. To date 3 focus groups with students across 2 institutions over a period of 6 months were carried out. Two focus groups were conducted in one institution with 8 and 10 participants respectively, whilst a third one was conducted in another institution with 5 participants.

A strategic type of sampling was applied where the size of the sample in terms of how representative is less of a consideration (Buchanan and Bryman 2009). Rather the key question for this research was whether the sample could provide accurate enough data, with

the right focus to enable the research to address the research question (Silverman 1997). The questions in all the sessions (interviews and focus groups) focused on three key aspects: how energy content was considered in practice and education, how learning on energy related issues was obtained and how outcomes on energy related issues were assessed. All discussions started with overall views on the approach of the school to teaching energy related content, its overall philosophy and perceived mission.

***Data analysis***

The data was collated into a data bank and analysed in NVivo initially using descriptive themes (Buchanan and Bryman 2009) grouped under the topics discussed: *positioning of energy related content in teaching and learning*, *approaches to teaching and learning*, *assessment of energy* and *the school views*. This descriptive coding resulted in an initial understanding of how energy related content was described and promoted in the specification and delivery of learning, teaching and assessment of energy related content. The second stage of analysis focused on exploring themes in relation to literature on evaluative practice and in particular categories of: use of specific procedures, use of formal criteria and disciplinary soveirgnty as advocated by Lamont (2012). See tables 2 and 3 for coding across students' and educators' views.

<<Insert Table 2 here>>

Table 2 shows educators' views key themes. Each category (use of specific procedures, use of formal criteria and disciplinary sovereignty) was examined against each theme noting number of references against each subtheme. Table 3 shows students' views against the key themes.

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## Findings

Findings are discussed under the key themes that emerged from the analysis: *Positioning of energy related content, Approaches to teaching and learning* and *Assessment of energy*. The data suggests educators and students share common views on how energy related content is positioned within curriculum as well as school approaches to curricula development. However, regarding teaching and learning different expectations and perceptions of delivery emerge. For educators, discussions focus primarily on identifying problems related to curriculum delivery, staff interests, different course structures and deep rooted divisions between academic staff, the institution and professional body validators. Students views on the other hand coalesce around personal journeys into education and within their own courses. In addition, a number of students reflect upon the value and importance placed on aesthetic judgement over energy related content by some design studio staff. Each of the key themes are discussed in detail below.

### *Positioning of 'integrated' energy related content – educators' and students' evaluation*

Energy related content is reflected upon by educators as broadly integrated and 'embedded' within curricula. Programme specifications, though not mentioning energy specifically, often reference environmental and sustainability issues as integral to course delivery. Integration was viewed in different ways as notionally present but not explicitly identifiable particularly in assessment processes. Throughout the interview and documentary data key aspects of how energy was integrated were intertwined with issues of deep rooted divisions and disconnects between staff. On the other hand, students' views coalesced around the influences of design studio staff interests and motivations and needing to align design outcomes with staff interests.

### *Educators evaluative practice - Keeping the status quo – disconnect between staff*

For most educators, programmes were viewed as driven primarily by a school' design agenda' and mostly in the hands of 'design studio staff'. One participant initially conveyed a

successfully integrated course, describing energy-related content as central to research in the school but not a big design driver.

> "Well, it's very central in terms of our research and that does filter down a little into our teaching but …It's not a big driver in terms of the design agenda and to be brutally honest, I think it's considered as an add-in when it comes to design agenda in the school…" (Participant 16 Case 26).

A number of participants discussed curriculum changes over time and a sense of losing "a very explicit thread of thinking things through sustainably" (Case 21). The syllabus overall is described as containing the required energy-related content. However, when discussing how the content was delivered, educators conveyed a sense of uncertainty and need for explicit outcomes. Overall, educators discussed a strong placement of design studio teaching at the core of the curriculum overshadowing other aspects of curricula such as environment and technology.

Differences in disciplinary backgrounds as well as physical separation of studios from other taught modules were viewed as a key obstacle. Participants described energy-related content as the domain of "people who have a building physics background, rather than an architectural background" (Case 23). Some participants conveyed a sense of physical separation between technical and non-technical staff viewing integration between energy related content and the design studio staff as requiring better 'physical' linkages:

> "…I really wanted to integrate the construction thinking into a housing project and we used to do that by getting the technical staff, literally, to show their face in the studio…" (Participant 15 Case 21)

For many the issue of having a non-architectural background meant that students found the 'energy related' coursework as a distraction and "not particularly relevant" to the creative design studio part of the course. Participants also discussed the difficulties of allocating sufficient time and finding "time for the students to be able to think about design in creative terms and putting lots and lots of energy aspects into it" (Case 24) meant that their time became restricted. Students were found to respond to "an energy issue through their design work" whereas when particular 'technically based staff' "set them a more academic assignment, I think they sometimes see it more as a box ticking exercise, they've got to do it, so you're not being creative in helping their design project" (Case 23). Also, future students are seen as not being "treated fairly", entering an industry that is tasked with delivering

nearly-zero carbon buildings and not having the competencies or skills needed (Participant 24 Case 9).

Most participants discussed the importance of architects' future role and the need for developing analytical and technological based skills. Tools (related to energy simulation) are seen as "becoming so much more user friendly…and part of normal architectural skills". The role of the architect is also seen as changing to encompass "people doing the calculations". Architects are seen as not needing to "do the structural or energy calculations, but…needing to have an idea of whether the person who's doing the calculations is actually in the right order of a magnitude, or doing the right thing" (Case 27).

Particular traditionally engineer assumed roles are seen as increasingly accessible to architects due to advances in technology and increasingly user-friendly design tools. In addition to changing roles of future architects, a number of discussions emphasise the changing role of architect-validators. One of the participants described how a more ambitious energy-related course would be faced with difficulties due to 'an overregulated programme…resistance from staff, particularly those based in practice who are just doing what they do…" as well as RIBA validators who tend to view 'energy related content' as fairly unimportant (Case 9).

***Students evaluative practice - Aligning with design studio staff***

Students were also asked to reflect upon how they positioned energy related content in their courses. Most students discussed the role of studio tutors as being of primary importance describing how the tutor's personality, likes and motivation shaped the studio projects. For one student energy-related content was not rated highly or it was not viewed as part of the overall architectural ambition on the agenda of the studio module.

> "In terms of tutorials…energy related content in my experience is not (on) the agenda so to speak…if you choose to push it yourself you'll probably find support." (Participant 25 Case 26)

Other students noted how their design projects' integration of energy content depended on tutors' personalities; this experience varied from year to year. Student 28 (Case 21) observed the importance of having an inspirational technology lecturer "who was capable of igniting interest". She also noted how exposure to practical examples was paramount to understanding of environmental issues including energy discussing how "there is a difference between

passing a brick in a lecture theatre and going on a site" (Case 26). Another student similarly discusses how learning on sustainability issues often does not occur through formal teaching but through passion from particular tutors.

> "Yeah, tutor Y is passionate about it, but we're not taught it in studio, you're encouraged to apply it by the different tutors. For example, last year, we weren't that encouraged to apply it, this year we have been…"( Participant 27 Case 26)

Students conveyed challenges with managing an architectural aspiration and a building that fulfilled all the required environmental credentials. For many students, studio tutors are seen to initially "push" an architectural ambition and then laterally ask students to "see how it works energy wise" (Case 26). Students recognise the fact that their initial starting point in design often "had nothing to do with sustainability". For most students, schools are seen as being "relatively non-prescribed in terms of architectural style." However, energy related content is often viewed as a practical 'prescribed' aspect of research rarely "filtering into teaching". For many students, the starting point in a project was seen as a clear pathway to how the project/ and career in some cases might end up.

***Teaching and learning of energy related content – educators' and students' views***

Educators as well as students discussed their experience of teaching and learning as a personal journey; often comparing life experiences to experiences in education settings. Overall both emphasise the need for energy related content and current lack of application. However, although both identify need, there is a shared observation of difficulties of adapting or extending current complex curricula. Educators discuss their teaching as being driven by a personal stance, whilst students discuss their learning being guided by a tutor's particular approach.

***Educators' evaluation - Personal experience, need and motivation***

Educators often discussed how particular approaches needed to change by reflecting upon personal judgement or knowledge in a particular area.

> "My personal take on it - 'cos I teach a lot of similar simulation, digital simulation and I think, probably from my perspective because it's now becoming so embedded in the software and still kind of user friendly, that I think it's so easy now, why would a designer not want to run a simulation, or not want to because the actual in their

> design, so my view would be that that should become just part of the routine tools of an architect. Probably, with a lot of our staff because they're not familiar with those teacher tool skills, they probably see it as a very onerous task, for example, to run an energy simulation…" (Case 27)

Also, educators often referred to their experience of being a student and ways energy related content was taught. One participant discussed his experience of being a student as not very user-friendly and not particularly enjoyable as one of 'doing spreadsheets and calculations'. He compared his experience to current students' environment filled with 'user friendly tools' and being highly enjoyable making learning an approachable one.

***Students' evaluation – Increasing complexity***

Although most participants recognized the need for change many observed difficulties in implementing any change. For educators, curricula were seen as stretched whereby new issues would continually be added whilst current ones 'were never taken away'. This 'packing in' of curricula was viewed as making students engagement more difficult. For others, lack of engagement was viewed as widespread amongst staff and students. Staff was increasingly given additional tasks 'asking many to do something extra, even if it is just respond to, can sometimes be a problem'. Staff were then viewed to 'stick to what they know' and defer expertise to others. For many, shortage of time was seen as an important factor that contributed to a lack of in depth teaching.

> "And I do wonder, we move so quickly through the curriculum, that you just never get the chance to really slow things down and to start to really have long discussions about some of the work they're doing." (Case 21)

For students, growing complexity of curricula was also discussed. However, in students' discussions complexity was viewed as covering subjects broadly, disengaged staff and curricula needing to respond to students needs more readily and in more integrated ways.

> "We need inspiring tutors to show us that and off we go, we're good, we can take it from there I think, yeah, get some interesting engineers, or crazy builders, or something like that." (Case 26)

Another student recognized the increasing complexity of curricula and time limitations suggesting 'inserting more' meant that something had to get taken out unless it was condensed.

***Assessment of energy related content***

Assessment of energy related content was mostly loosely discussed with most participants not engaging in describing technique or detail. For some there was an uncertainty of how the issues were assessed at all:

> "…thinking about the construction teaching narrative across the undergraduate programmes and it's made me think about it and think that, actually, it's not particularly explicit, so I might be being slightly over critical, self-critical, but I'm not sure how well we are assessing it now…" (Case 21)

For other participants being specific about what was assessed, became a difficult issue to describe noting how many aspects of architectural curricula are often not explicit.

> "…one of the things that's probably true, and will remain true no matter what we do to some extent, but what we, collectively, not just our institution, but what we do often, I think, on architectural courses, is we cover a whole load of stuff that is not explicitly mentioned in learning outcomes, or criteria, or even synopsis, or whatever in a module and part of the task" (Case 12)

For many students, time and confidence to pursue a project's sustainable ambition was seen as a major stumbling block. Students conveyed a sense of having to rush through modules, complete work quickly and move on to the next task without being able to explore and experiment fully.

> "…I feel like I haven't totally resolved my building as much as I would have liked to, to the point of really understanding exactly how all the details work, how the windows fit. At the moment, it's like resolving the outside, it takes so long, that the inside kind of suffers as a lack of it. Even just thinking about, like I don't know every material finish on the interior of my building…" (Case 26)

***School philosophy and approach***

Educators mostly viewed their school as meeting expectations of practice in their outlook but not necessarily delivery. Although they note how a vision set out by a school is 'appropriate to practice' and meets 'global challenges' many also discussed how it did not prepare students to meet those demands.

***Educators' evaluation – Fitting into the real world and not meeting expectations***

Participant 15 (Case 9) notes how his school is not about 'following a mantra of any kind' but rather about 'making architecture as appropriate to its place, appropriate to its culture, appropriate to climate'. For many participants, a schools' philosophy is about preparing students for the 'real world':

> "…I'd say that it's very much practice and design oriented. In other words, the school is training people really to do professional aspect(s) of architecture, rather than any academic, or theoretical type(s) (of) investigation; so they're interested in training people who will become working architects, more practical, as I say, than theoretical I think…"

However, though noting how schools aim to prepare students for practice to be able to tackle real life situations and problems, most educators observe how schools rarely achieve that level of preparation:

> "…Do you think that when you graduate and you go on (a) year out that you're actually ready to design a building ... no, I don't. In one way, the students don't think they are, lots do. In practice, if you asked the question 'do you train students up to be able to handle technology, etc., etc., and work on it?' ... Yes, we do." (Case 25)

Students tended to highlight how schools did not meet their expectations. One of the students discussed her expectations of what the course may be teaching her and conveys her disappointment with regards to sustainability learning and experience in particular.

> "…One of the reasons I came to University Case C is (that) I saw it as a leading institution that promoted sustainable ideas and I thought that would be steeped in the culture of the university…I was a little disappointed when I came here…there is a conventional approach to sustainability…not an in-depth approach…" (Case 26)

When asked to describe how they perceive design teaching overall and energy related content in particular students often observed and noted their views on the school's perceived image.

Students also frequently reflected upon their early perceptions and expectation of the course they entered and specifically what they thought they would learn and how this changed over time. One student described how she had thought environmental design encompassed primarily everything related to landscaping and how this thinking developed over the duration of the course.

> "…That's that I thought when I signed up, I thought 'oh yeah, we'll be looking at green stuff (outside) all the time,' but it's actually the environment within the building…" (Case 21)

Several students conveyed a sense of dissatisfaction with their course in terms of a lack of direct link with practice and practitioners who practice environmental techniques. Energy related content and environmental principles are viewed as requiring a type of superficial representation.

> "…There is a point in second year where every project has a sun-path diagram…the issue is it is not informing design…it is just there…there is an ignorance between those insights informing design…" (Case 26)

**Discussion**

Both educators and students draw on personal experience and motivation to discuss their views and justify approaches. Also, students as well as educators recognise the perceived peripheral value that is placed on energy related content by the school agenda and design studio staff. In both cases studio staff are viewed to filter what is done in a design project and how a brief is interpreted and ultimately assessed. For educators, there is an expectation that the profession will have to change, that important issues are being overlooked and that eventually they will be addressed. However, change is viewed as 'something that is initiated and actioned by others'.

For students, the focus is placed on ways to improve their school, to what extent and level of detail energy related content needs to be taught – in particular there is a greater focus on needs at a global level. Expectations for students lie with tutors and the school; for educators with the profession, policy and governments.

The study contributes to education and practice research on energy in architecture in several ways. First, the findings reflect upon some of the ways students and educators

evaluate teaching and learning of energy related content. The views of both groups are justified by drawing on personal experience rather than disciplinary sovereignty as discussed by the evaluative practice literature (Lamont 2009). It also contributes to research on evaluation that examines individual approaches rather than peer review, experts or validators (Camic *et al.* 2011). In this study, prior education, life experience or knowledge is often referred to when justifying expectations, the status quo or need for change.

Second, the study extends current pedagogical studies on sustainability education in the built environment that describe the institutional and curricular barriers educators face (Murray and Cotgrave 2007). In this paper students' views are also discussed and the barriers they perceive are identified as tutors' personalities, institutional complex curricula and the professional emphasis placed on design. In addition, though many issues are viewed as obstacles, educators are seen to be reluctant to change the status quo.

Although students' views are often overlooked, they provide an important and valuable evaluative perspective. The study also has implications for work on energy literacy that focuses on measuring attainment (De Waters and Powers 2011). Students viewed working across modules and with different staff requirements, needs and interests as a major stumbling block in learning energy related content. Some of the methodological issues in learning energy related content would benefit discussions in energy literacy. Most studies on energy literacy in higher education (Cotton *et al*. 2015; Soares *et al*. 2014; De Waters and Powers 2011) view students as participants whose energy literacy levels are assessed and measured and whose engagement, knowledge and skills requires improvement. The analysis in this study presents views from students on how energy education is shaped, their perceived views of energy learning and their role as future architects.

Finally, there is a contribution and implication for UK built environment education and construction energy policy that calls for an energy literate workforce. Although educators perceive the content of curricula covered energy related issues, the delivery was not perceived to enable students to be energy literate. Unravelling some of the institutional, disciplinary and structural issues with curricula assessment and validation is much needed. In addition, providing guidance that would encourage and assist in providing staff development and training to enable meeting energy policy expectations is much needed.

## Conclusion

The analysis carried out for this paper shows a potential qualitative method of studying approaches to teaching and learning energy content in architecture that takes into consideration the different participants and their views. Although the study has focused on undergraduate architecture education and practice in the UK, there are implications for the wider built environment domain and policy on energy education more broadly. Examining construction industry's multiple overlapping professions as well as other cultural contexts will enable further insights. In addition, more theoretical contributions are needed in the longer term, including a consideration of energy against other empirical design and construction concerns.

Much research, policy and practice has focused on addressing energy concerns in building design with an emphasis on design, operation and management practices with less attention devoted to exploring learning and teaching. There is growing consensus within government construction policy (HM Government 2011; Zero Carbon Hub 2014) practitioner design guidance (Sullivan 2012) and academic literature (Hartenberger *et al*. 2013) of the need for an energy literate workforce. The shaping of energy beyond secondary school education is not significantly reflected in either literature in the architectural domain or research on sustainability in built environment education; nor are they addressed in current policy. As questions of energy in education and practice are increasingly measured quantitatively through benchmarks and standards, understanding the qualitative shaping of understandings that underpin those measures is critical.

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