WHAT DO WE SAY WE TEACH ABOUT ENERGY? VIEWED THROUGH THE LENS OF UK ARCHITECTURE UNDERGRADUATE EDUCATION

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Abstract: Changes in recent EU policy highlight the need for improving building professionals' knowledge and skills regarding energy considerations in building design and construction. The architectural and engineering educational sector in particular is tasked with equipping graduates with the required competencies in order to be able to contribute to a fast-developing energy agenda. Although significant attention is placed on improving knowledge regarding energy in buildings in the industry sector there is less discussion across the UK professional bodies or research on the sort of literacy competencies students require to meet the growing industry and policy demands. Architectural education in the UK is monitored and validated by its professional bodies. Although curricula are required to embed sustainable development within their accreditation criteria for instance, it is less clear how energy considerations are met. The purpose of this paper is to examine how architectural educational institutions provide energy content in their undergraduate curricula. The study analyses 22 out of 45 accredited architecture undergraduate course programme specifications with a focus on exploring how energy content is described in both the learning outcomes and assessment. Preliminary findings demonstrate a varied and at times conflicting set of approaches with emphasis placed on cognitive literacy attributes of understanding and awareness with less consideration of behavioural or psychomotor attributes and little clarity in other cognitive dimensions such as knowledge and skills. The contribution of this paper is twofold. First, the findings provide an initial overview of how energy content is considered in curriculum design in architectural education in the UK. Second, the study considers the attributes that shape energy literacy in the context of architectural undergraduate education. There are also implications for policy development in other related educational curricula in the built environment including engineering, architectural technology, planning and surveying.

1 INTRODUCTION

Recent EU policy has committed the UK construction sector to meeting a reduction of 20% in the EU's total energy consumption by 2020, and the UK's energy consumption by 60% by 2050 (EPBD 2010). Industry and governmental initiatives have begun to articulate some of the needs required for practitioners in terms of meeting the EU targets with particular emphasis placed on narrowing the 'performance gap' between predicted and actual energy use in buildings. Zero Carbon Hub's end of term 2014 report discusses energy literacy as an objective for practitioners to attain through training and upskilling (ZeroCarbonHub 2014). The report reflects upon the need for evidence and demonstrative value of gained knowledge on energy literacy with importance placed on 'awareness, skills and knowledge in performance' (p 20). The Royal Institute of British Architects (RIBA 2008) in their report on 'Climate Change Toolkit-Carbon Literacy Briefing' reflect upon the key carbon emission issues and the need for greater carbon literacy awareness amongst practitioners. Although both construction policy and industry articulate lack of knowledge across the industry domain and a need for retraining and upskilling, less attention has been directed to improving or clarifying current pedagogical requirements regarding energy issues in architectural education and more widely across the built environment.

Architectural education in the UK is monitored and validated by its professional bodies. Professional bodies such as Royal Institute of British Architects/Architectural Registration Board (RIBA/ARB) base criteria for prescription/ validation of Part 1/2 qualifications on the requirements of article 46 of the EU Qualifications Directive (2005/36/EC). Curricula currently follow a three-part route, which is administered by the ARB in respect of the protected title of “architect”. This route is also adopted by the RIBA as a condition of membership. Part 1 is usually undertaken through full-time undergraduate study of not less than 3 years. The syllabus covers 5 themes including design, communication, technology and environment, cultural context and management, practice and law with specific focus on developing students’ awareness, knowledge and abilities (RIBA 2003). Prescription/Validation criteria include specific learning outcomes across the themes. Energy issues are not prominent, however, broad aspects relating to “understanding of environmental strategy” (GC.1.2), “the needs and aspirations of building users” (GC. 5), “the impact of buildings on the environment and the precepts of sustainable design” (GC.5), “environmental impact of specification choices” (GC.8.3) and the “principles of designing optimum visual, thermal and acoustic environments” (GC.9) are outlined across the learning outcomes.

Although curricula are required to embed broad sustainable development issues within their accreditation criteria, it is less clear how energy considerations are met. In addition a limited area of research has discussed or defined attributes of energy literacy in the context of university built environment education. While considerable scholarship has examined meanings associated with defining literacy more widely (Comber and Nixon 2008; Freire 2000) few have explored energy literacy issues in the context of built environment or architectural education. Recent work by de Waters and Powers (2007; 2011) begins to shed some light on the topic of energy literacy in the context of secondary school education in US. Their research contributes by identifying some of the ways by which energy literacy could be evaluated through critique of current assessment methods that “do not reflect energy literacy but rather student achievements with respect to predetermined specific energy related content” (2007: 1700). However, their empirical setting involves secondary school students in the US and though valuable does not fully reflect upon the sort of parameters required of university students in the construction sector for instance.

The purpose of this paper is to examine how architectural educational institutions in the UK account for energy content in their curricula in order to reflect upon some of the likely energy literacy dimensions in the context of built environment education. The following sections discuss relevant literatures on defining literacy attributes more broadly as well as recent empirical work on energy literacy. It is followed by an outline of the research setting and method. Following on the findings section, the discussion and conclusion outline key implications and contributions of the research.

2 LITERATURE REVIEW

Literacy studies are a subject of a growing educational and sociological literature. Rocap (2003:64) defines literacies as a “range of practices, institutions, events artefacts and socially defined and valued competencies that come to be associated with dominant uses of the term”. Freire (2000) describes literacy broadly as a phenomenon constituted through cultural and personal identities. Many typologies of literacies are discussed from cultural (Hirsch 1988), ecological (Orr 1992), technological (Pearson and Young 2002), transformative (Freire 2000) and visual (Elkins 2010). In light of increasing developments in technology and new ways of learning and communicating a number of scholars formed the New London group task force in 1994 to understand literacy in the context of life in the 21st century suggesting educational studies needed to account for ‘multiple literacies’ (Cope and Kalantzis 2000). In more traditional discipline-based fields, literacy is typically measured through proficiency in a set of critical skills. However, with developing agendas on energy, sustainability and technology, recent debates question the applicability of established measurement criteria calling instead for research that opens up a deeper understanding of literacy specifically as “increasing governments are attempting to contain it and limit it” (Comber and Nixon 2008:223). Despite wider acknowledgement that literacy practices related to energy and sustainability are increasingly situated within and shaped by both local and global trends, material and virtual spaces and places (DeWaters and Powers 2013), few studies have examined their shaping from a socially situated perspective.

Recent work by de Waters and Powers (2007; 2011) focuses on identifying the levels of energy literacy amongst secondary school students in the US. In defining initial parameters by which to evaluate energy literacy de Waters and Powers (2011) build upon work carried out in the field of technology and environmental science. Their study draws on technological and environmental literacies to encompass three dimensions of an energy literacy scale based on - cognitive (knowledge, understanding, skills); affective (sensitivity, attitudes) and behaviour (activities) dimensions. The methodological approach undertaken by De Waters and Powers (2007, 2011) is rooted in quantitative data collection and analysis techniques whereby measurement criteria are validated by a panel of experts and consequently measured in surveys. The survey devised by De Waters et al (2009) has recently been applied in a sample of 2400 secondary students involved in a national energy education program in Taiwan (Lee et al. 2014) showing potential wider applicability. Their research contributes by identifying some of the ways by which energy literacy could be evaluated, however, their empirical setting involves secondary school students and though valuable does not fully reflect upon the sort of requirements and parameters required of university students in the construction sector.

Although limited work has examined aspects related to energy literacy in built environment education, an emerging research agenda investigates features related to environmental literacy and sustainability education approaches. Scholars tend to focus on two aspects relating to environmental literacy and sustainability education: barriers to curriculum integration (Altomonte et al. 2012; Cotgrave and Alkhaddar 2006; Pan et al. 2012; Peel 2010; Peel 2012) and guidance to overcoming current limitations (Alahmad et al. 2011; Batterman et al. 2011; Murray and Cotgrave 2007).

Discussions that propose ways of incorporating sustainability concerns into built environment education outline the hindrances or opportunities to successful integration. Pan et al (2012) suggest the key barriers to successful implementation of sustainability concerns are found in conflicting approaches to research versus teaching amongst students, lecturers and the institution. Furthermore, the professional obligations and academic interests of lecturers were suggested to be interwoven with the learning and career expectations of students, resulting in a complex network of relationships between research and teaching within the discipline. Their study identifies strategies for advancing sustainability research-informed teaching which require simultaneous input and support from a wide range of stakeholders including industry professionals, university policymakers, lecturers and students. Similarly, Cotgrave and Alkhaddar (2006) discuss barriers to achieving environmental literacy in the construction education sector. The barriers 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 barriers are to be found 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. They suggest ways forward are to be found in a European wide Action plan that promotes the implementation of sustainability principles in architectural education.

A number of scholars have 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. Batterman et al (2011) review existing educational programs at more than 20 universities in Portugal identifying educational competencies in the area of energy and sustainability in the built environment. Their findings summarise the overall nature and use of competencies in education planning and assessment and propose model competencies for two specialties including “Buildings and Urban Environments” and “Energy Systems and Policy”. Competencies are ranked through a set of priorities and applied in the development of a multidisciplinary master’s and doctoral programs at the University of Coimbra. 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. Ferreira et al (2009) suggest environmental engineering courses fail to provide the students with the required ‘sustainability’ skills. They propose the integration of an Environmental Management System on campus to ensure students are exposed to ‘hands-on’ skills that will make them useful in practice.

However, few studies have examined empirically or theoretically how educators 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.

3 RESEARCH SETTING AND METHOD

The study is based on a qualitative approach using documentary evidence. Scott (1990) refers to the use of 'documents' in social research, which provide a record of the social world. The documents in this context are "socially produced", reflecting a society at the time of their publication. A broad definition of a document is a ‘written text’ which “must be studied as a socially situated product” (Scott, 1990: 34). It is defined as “any written material other than a record that was not prepared specifically in response to some requests from the investigator” (Guba and Lincoln 1992:228). Recent studies on multiple literacies call for qualitative approaches that provide a deeper richer account of literacy dimensions (Comber and Nixon 2008). The approach in this paper responds to this wider call drawing on sets of documentary evidence including professional body validation criteria reports, undergraduate architecture course programme specifications and architectural education briefing guides. Table 1 shows types of documentary evidence collected and analysed in the period Aug 2014 to Jan 2015.

Table 1: List of documentary evidence collected (Aug 2014-Jan2015)[1]

Type of evidence	Reference and date of publication
Professional body criteria	ARB (2010) Prescription of qualifications, ARB Criteria at parts 1,2 and 3
Briefing guides	CEBE Briefing Guide Series 11 Problem based learning in architecture
Curriculum design guidance	EDUCATE (2012) Framework for curriculum development
White paper	EDUCATE (2012) sustainable Architectural Education
Professional body validation criteria	RIBA(2011) Validation criteria at part 1 and part 2
Undergraduate Programme Specification	AA Undergraduate School Programme guide (Case A)
Undergraduate Programme Spec.	University of Bath form QA3-2 BSc Architecture (Case B)
Undergraduate Programme Spec.	Birmingham City University BA Architecture (Case C)
Undergraduate Programme Spec.	Bournemouth University BA Architecture (Case D)
Undergraduate Programme Spec.	Coventry University BSc Architecture (Case E)
Undergraduate Course Spec.	University of Greenwich BA Architecture (Case F)
Undergraduate Programme Spec.	University of Cambridge BA Architecture (Case G)
Undergraduate Course Spec.	University of Kent BA Architecture (Case H)
Undergraduate Programme Spec.	The Glasgow School of Art BArch (Case I)
Undergraduate Programme Spec.	University of Lincoln BA Architecture (Case J)

[1] A list of RIBA/ARB accredited undergraduate courses was obtained from the RIBA report on ‘UK Schools of Architecture with courses validated by the RIBA’ updated 30th September 2013. Programme specifications, validation criteria and briefing documents obtained in 2014 from relevant web-sites of the Universities and accrediting bodies.

Undergraduate Programme Spec.	Liverpool John Moores University BA Architecture (Case K)
Undergraduate Programme Spec.	London South Bank University BA Architecture (Case L)
Undergraduate Programme Spec.	Northumbria University BA Architecture (Case M)
Undergraduate Programme Spec.	Nottingham Trent University BArch Course (Case N)
Undergraduate Course Spec.	Oxford Brookes University Course BArch (Case O)
Undergraduate Course Spec.	University of Portsmouth BA Architecture (Case P)
Undergraduate Course Spec.	University College London BSc Architecture (Case Q)
Undergraduate Course Spec.	University of Central Lancashire BSc Architecture (Case R)
Undergraduate Course Spec.	University of Ulster BA Architecture (Case S)
Undergraduate Course Spec.	University of the Arts London BA Architecture(Case T)
Undergraduate Course Spec.	University of West of England BEng Architecture and Environmental Engineering (Case U)
Undergraduate Course Spec.	University of Westminster BA Architecture (Case V)

The data was analysed in NVivo initially using descriptive themes (Richards 2009). A theme captures something important about the data in relation to the research question and represents some level of patterned reasoning within the data set (Richards 2009). Descriptive themes are valuable in getting the analysis started as well as summarising segments of the data. An analytic theme pulls together material into smaller higher level units. The initial stage of the analysis focused on the identification of codes related to overall course programme aims, learning outcomes and teaching process as well as exploring how energy related content was described. This coding resulted in 40 initial descriptive codes from which 4 key themes were extracted around course aims, course outcomes, course process and energy related content. First order codes were then compared to text segments to understand how these concepts related to similar ideas (see Table 2). Examples of first order codes include 'pluralist'; 'integrate' 'develop and demonstrate' and 'relationships'. As themes started to emerge literatures on design pedagogy, environmental, sustainability and technological literacy were explored.

Table 2: Descriptive codes related to documentary evidence

Course Aims	**Course Outcomes**	**Course Process**	**Energy related content**
pluralist	skills	assessment closed	**relationships**
expectations	integrate, organize	assessment open	**strategies**
role of the architect	awareness and engagement	assessment peers	**impact**
the design studio and portfolio	develop and demonstrate	assessment teacher	makeup
equip and enable	encourage and apply	learning within	feel
employment	design and creative thinking	learning across	outlook
autonomy	abilities	teaching specific	pursuit
requirements	values and attitudes	teaching wide	use

4 FINDINGS

Preliminary findings suggest that energy related content is rarely referred to in the data (exceptions include cases D,E,F and U), however, broad environmental issues are reflected across three key themes: *relationships*, *strategies* and *impact*. The key themes (relationships, strategies, impact) are discussed below in terms of their consideration to learning outcomes and the overall teaching/learning process.

'Relationships'

Initial observations suggest that environmental/sustainability related content is discussed in broad terms as notional attributes situated across the learning spectrum primarily through dimensions of 'awareness' and 'understanding'. *Relationships* are discussed in several ways: *between a single unit and the greater good*; *between specific subjects and the discipline* and between *overall strategy and a specific response.*

Across several cases descriptions related to environmental concerns often revolve around an individual response and the greater good. For instance in Case D architectural learning related to the environment is described as mediation between the individual and others.

> "…A working theory of architecture explored is the reflective practice of making tangible, thoughtful, inhabited places that mediate between the individual, the world and others..." (Case D)

Similarly in Case T learning is described as facilitating broad interests and focused approaches. Energy-related content is outlined as a specific 'technological' component that becomes integrated into design. In addition students' understanding in respect of environmental concerns is described as 'abilities to integrate' and 'relate' specific technological solutions, strategies and responses to "human wellbeing the welfare of future generations the natural world" (Case M). Students' understanding is seen as being "responsive to a broad and divergent constituency of interests and to the social and emergent ethical concerns related to a brief" with awareness viewed through abilities of "producing a design which integrates complex climate, service and energy supply systems (Case T)". Awareness is also discussed in terms of acknowledging interfaces between 'architecture and sustainability' (Case P) as well as "understanding of the relationships between building technologies, environmental design, sustainable design and the needs of future generations"(Case L). In addition, *relationships* are described through making "connections between subject discipline and the professional environment "(Case K), as well as through "integrating building fabric (materials), services and control regimes into a unified environmental design "(Case H).

Strategies

In addition to awareness of multiple relationships, discussions focus on the notion of *strategies* obtained primarily through understanding. Strategies are referred to in terms of *integration of different components* (construction, environment) as well as an *overall and explicit one*. For instance, across several cases emphasis is placed on understanding of strategies "for building construction, and ability to integrate knowledge of structural principles and construction techniques" (Case A) and knowledge of strategies "for building services, and ability to integrate these into a design project".

Understanding is outlined in terms of designs being supported by "an explicit strategy for dealing with structural loads (gravity, wind etc.), energy (heat, light, sound, vibration etc.) and for the choice of materials" that "together contribute the architectural expression of the proposition" (Case I). Explicit strategies in terms of 'environmental design' are seen as supporting the "architectural expression of the self-directed design project" (Case H). Energy related content is also discussed as an explicit strategy with regards to heat, light and sound that "together contribute the architectural expression of the proposition" (Case I). An explicit strategy related to primarily building services is discussed as one that needs integrating into an overall design, expression or vision of a project. In addition understanding is described in terms of overall "environmental strategies and the regulatory requirements that apply to the design and construction of a comprehensive design project (Case S)".

Impact

Within a number of cases frequent reference is made to the importance of understanding *impact* in terms of buildings on the environment and in terms of sustainable approaches on design overall. Within Case D for instance descriptions of energy related content evolve around a specific "understanding of the impact of buildings on the environment" as well as a wider awareness of "the precepts of sustainable design". Impact is also discussed in terms of potential effects of buildings on society, the wider community and the "the welfare of future generations" (Case F). In addition to wider effects impact of energy related content is also described in terms of how it affects design. For instance, in Case O energy related content is discussed in relation to its impact on "the way in which buildings fit into their local context" as well as "appropriateness to site and context" and "environmental impact of specification choices".

5 DISCUSSION AND CONCLUSION

This research has provided a preliminary insight into ways energy content is considered in undergraduate architectural education in the UK. The findings have demonstrated that energy related content is situated within broader technological, environmental concerns and is primarily discussed through 'awareness' and 'understanding' attributes across *relationships*, *strategies and impact* themes. Skills and knowledge though featured across issues of design, management and communication are not specifically elaborated upon with regards to energy related issues. For instance, when describing course aims a number of cases state the importance of employable and transferable skills, knowledge regarding the role of the architect and multiple abilities to communicate across disciplines, design typologies and cultural contexts. The professional syllabus focuses on developing students awareness, knowledge and abilities (RIBA 2003); attributes derived from Bloom's taxonomy of educational objectives within the cognitive domain (Bloom et al. 1956). The attributes are largely accepted and rarely examined in detail specifically related to particular issues such as energy or sustainability. Instead changes in curriculum have mainly been in integrated in a fragmented way with emphasis placed on the 'cognitive domain' and in response to industry changes in emphasis over particular policy issues over time (Nicol and Pilling 2003).

Despite growing concern regarding the content and mode of delivery regarding architectural education overall and sustainability concerns specifically (TheOxfordConference 2008), few studies have examined the ways educational attributes have been interpreted. In addition, a dearth of research has analysed how particular areas of the syllabus such as energy have been included. Detailed analysis of both how skills, knowledge, abilities and awareness have been interpreted in architectural education regarding energy content as well as a wider consideration of the relevance of these attributes to the shaping of energy literacy needs to be undertaken. Future work could examine views and concerns from educators and students as well as take account of practitioners' perspectives. Also, further research could delve deeper into specific subject areas and module specifications.

Although the study has focused on undergraduate architectural education in the UK, there are implications for the wider built environment domain and policy on energy literacy more broadly. The shaping of energy literacy beyond secondary school education is not significantly reflected in either literatures in the architectural domain or research on sustainability in built environment education; nor are they addressed in current policy. Energy is an issue that "governs how humans interact with each other and the environment they are situated within and arguably one of the most urgent and important issues in the 21st century" (DeWaters et al 2009). Moe (2013) calls for a "more ambitious understanding of the forms of energy in architecture" and "a more ambitious concept of formation". Detailed analytically grounded understandings of such conceptions would allow viable suggestions for insights into energy literacy to be discussed more fully as part of a wider educational agenda in architecture and the built environment more broadly including engineering, surveying, construction management and planning disciplines.

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