

Towards Education for Sustainability in University Curricula and in the Practice of Design

SERGIO ALTOMONTE¹, HANA REIMER², PETER RUTHERFORD¹, ROBIN WILSON¹

¹ Department of Architecture and Built Environment, University of Nottingham, Nottingham, United Kingdom

² Department of Building Climatology and Building Services, TU München, Munich, Germany

ABSTRACT: Education for sustainability is an emerging imperative, requiring a paradigm shift in the way in which new generations of architects and engineers are taught within academic institutions and in professional training. In the modern university, the studio still serves as the forum for synthesising in coherent design the principles acquired in theoretical courses. However, technical teachings are often fragmented and alienated to applied coursework so that students are seldom able to deeply engage with an integrated design process centred on sustainability. Concurrently, the practice of sustainable design is not consistently supported by regulations and qualification procedures, whose prescription criteria are frequently characterised by ambiguous and inhomogeneous requirements. New pedagogical methods and the promotion of continuing professional development are needed to overcome existing barriers and facilitate knowledge transfer between scientific research and the creative implementation of sustainability in design. In response, the project EDUCATE (2009-12) was funded by the European Commission to promote the integration of sustainability at university and professional level. Building on its final outcomes, this paper aims to discuss the challenges - and the opportunities - that education and regulatory frameworks need to face to enhance the knowledge, skills, and competence in sustainability of students, educators and practitioners of disciplines of the built environment. Keywords: Education, Sustainability, Architecture, Curriculum, Qualification, Practice

INTRODUCTION

Education for sustainability is an emerging imperative, requiring a paradigm shift in academic and professional training. To this aim, priority should be given to the development of sustainability literacy as a 'core competence' among students and professionals. Education and training should move away from reductionist approaches, facilitating critical and holistic thinking, lifelong learning and the creation of multidisciplinary links between cognitive domains.

Awareness of the role that buildings play in the current climate crisis is bringing to the fore new responsibilities for students, educators and practitioners. Yet, regardless of the great corpus of knowledge produced by scholarly research, several pedagogical barriers still hinder the comprehensive engagement of academic curricula with sustainability. Concurrently, the promotion of a sustainable design practice is not yet consistently supported by professional bodies, whose prescription criteria are frequently characterised by vague requirements. As a result, a major advancement in pre- and post-professional education is needed to facilitate the dialogue between theoretical sciences and the exploratory application of sustainability in design.

In response to these challenges, the project EDUCATE (*Environmental Design in University Curricula and Architectural Training in Europe*, www.educate-sustainability.eu) was funded in 2009-12 by the European Commission's Executive Agency for Competitiveness and Innovation, under the Intelligent Energy Europe programme. The project aimed to

promote the integration of sustainability in the education and practice of design, offering underlying support to the development of pedagogical and regulatory frameworks at academic and professional level.

This paper aims to present and critically explore some of the outcomes of EDUCATE, analysing the barriers to the practice of sustainable design, the challenges for promoting sustainability in higher education, and introducing the two final white papers produced by EDUCATE: *Sustainable Architectural Education* and *Criteria for Professional Qualification*.

THE PRACTICE OF SUSTAINABLE DESIGN

Although most practices nowadays claim sustainability as core to their ethos, few recent buildings have lived up to these contentions. Conversely, where sustainability has proven to be a major design driver, energy efficiency and carbon abatement have often been prioritised over architectural creativity [1].

In order to build a picture of professional competence in the construction industry, an analysis of the international state of the art was conducted by EDUCATE in collaboration with regulatory bodies. Around 400 surveys were collected from building practices in some 40 countries, allowing extrapolating the main challenges, as well as the opportunities, for the pursuit of sustainability in the practice of design.

A synthesis of the results confirmed that the majority of respondents (88.1%) indicated sustainability as central to their approach to practice, whilst 84.9% stated

that sustainable design can provide a creative input to their work. However, several barriers still hinder the potential that an informed response to sustainability offers as a design driver, such as persisting misconceptions and/or misunderstandings amongst stakeholders of the building industry. Most respondents (60.8%) declared to be aware of the responsibilities that designing for sustainability entails, and that competence should be compulsorily required for professional qualification (71.9%). Yet, it was strongly felt that provision of these skills should be strongly reinforced in higher education (96.4%), and via Continuing Professional Development (86.8%). Existing regulatory frameworks were generally considered as not fully supportive of sustainable practices (42.7%), particularly in terms of mandatory benchmarks. Regulations, and prescriptive standards, were also seen to influence the way in which clients 'view' sustainability. To many, minimum standards can entail a ceiling on aspirations and, according to respondents, only 40.0% of private and 45.6% of public clients seem to be aware of the creative opportunities afforded by sustainability. Indeed, the perception of the professional market was that clients' demands are still driven mainly by minimisation of capital investment (90.5%), reduction of operational costs (82.2%) and aesthetic requirements (75.4%) [2].

When evaluated comprehensively, the results indicate a clear request to develop a pedagogical framework that caters for both, the needs of those working towards entry to the profession, and the ongoing demands of those already within it. Taking into account that the demands of the building market require continuous interaction with related disciplines and clients, there is great value to be pursued in providing a work environment where all stakeholders share the potential benefits of a sustainable approach to design. A critical examination of the outcomes also leads to prioritise expectations in terms of knowledge, skills, and competence that graduates should attain at each level of progression towards professional qualification. In essence, to support the implementation of sustainability in the built environment, the practice of design needs to blend technical abilities with a broader set of creative skills. Sustainability should not be considered only as a matter of energy efficiency, but rather as a complex multi/inter/transdisciplinary skill-set that emerges from commitment and expertise as well as a moral obligation. Professionals need the freedom to practice these with the support of all actors of the building market, and within a regulatory environment that encourages innovation, rather than being merely a set of benchmarks to satisfy.

As a result, for equipping practitioners to operate sustainably in a highly competitive, demanding, and dynamically changing industry, there is still work to be done, starting from the academic programmes in higher education and feeding into the Continuing Professional Development of practitioners of the built environment.

EDUCATION FOR SUSTAINABILITY

The perception of sustainability has recently shifted from a specialist technical concern to a more core position on the agenda of higher education of disciplines of the built environment, forming part of an overarching approach to be considered from the inception of a programme through to its completion.

An enquiry conducted by EDUCATE in more than 60 schools from around 30 countries, however, reveals that - in many cases - there still is inconsistency in the ways that sustainability has been embedded in academic curricula. Several higher education institutions still make a split between theoretical and applied teaching, with studio serving as the forum for synthesising in design the principles acquired in ex-cathedra courses. In the lectures, it is assumed that students learn the fundamental knowledge that then, in the studio, inform all aspects of design. However, technical teachings are often fragmented and alienated to applied coursework so that students are seldom able to fully engage with an integrated design process that creatively investigates the implementation of sustainability in design. In addition, students are often required to embark on design tasks with limited knowledge of the design process itself, and without having formed the basis of the conceptual framework within which solutions would be formulated. Hence, the divide between the application of scientific knowledge (or knowledge that pertains to sustainability) and its realisation in design is perpetuated [3].

Such misconceptions are exacerbated by a naive conception of the process of knowledge acquisition and application. Indeed, following a *transmissive* model of education, lectures are often structured linearly, taking students step-by-step through processes and techniques, but rarely developing imagination, creativity, perceptual or spatial skills. In this context, Gelernter [4] made the case that this pedagogy: "*assumes that the mind works in two quite distinct and sequential modes: first, the mind is stocked with general knowledge of potentially universal application; then, the knowledge is applied to practical problems. This treats the mind like some kind of simple filing cabinet [...]. The entire procedure is assumed to happen sequentially: first the folder is introduced, then filled and filed, then retrieved.*" Of course, educational literature has disproved this sequential approach to learning, and as Gelernter [4] explains: "*the two sides of knowledge acquisition and application must be attacked simultaneously.*"

Conversely, to promote a *deep* learning approach to principles and practices of sustainability, students should engage in analytic and synthetic processes, emphasising reflection and critical self-evaluation, and balancing design creativity with environmental, social, and economic responsibility [5]. In so doing, students should be exposed to holistic aspects of sustainability, while also developing a critical insight and awareness of those multidisciplinary problems that transcend

sustainability issues. Ultimately, sustainability should not be seen uniquely as an ‘addition’ to the design, but rather as an essential requirement of the process itself.

These barriers reinforce the notion that conventional pedagogies may not be appropriate for addressing the challenge of education for sustainability in the design studio. A fundamental restructuring of both the traditional studio culture and the modules within which core sustainability issues are taught is hence worthy of consideration. It seems obvious, therefore, that to ensure that competence of sustainability is integrated with creative design abilities of students, there is substantial pressure to re-evaluate the priorities that sit at the core of academic programmes, so as to support effective knowledge transfer and bridge the divide between the often conflicting domains of the theoretical lecture and the creative studio. Evidently, the achievement of these aims requires an intrinsic rethinking of existing pedagogical practices, whereas commitment, motivation, and empowerment toward sustainability should inform all areas of the curriculum and be shared widely - and enthusiastically embraced - by all students, academics, and administrators. Only looking beyond mere content can successful education for sustainability be achieved.

SUSTAINABLE ARCHITECTURAL EDUCATION

In response to the analysis of the state of the art, and following the development and testing of a pedagogical framework in support of education for sustainability, EDUCATE produced a final white paper on *Sustainable Architectural Education*. The white paper proposes a series of principles and practices - illustrated in terms of *mission agenda*, *learning outcomes*, *programme structure* and *pedagogical methods* - aimed at providing guidelines for curriculum development that can effectively embrace sustainability in academic programmes of disciplines of the built environment [6].

Agenda for Sustainable Architectural Education

The *EDUCATE Agenda for Sustainable Architectural Education* articulates in ten principles the ‘mission’ of a curriculum aiming to foster knowledge, skills, and competence in sustainability at all stages of education. Paraphrasing these principles, to support the design of buildings and urban spaces that can achieve comfort, delight, well-being and energy efficiency within a culturally, economically, and socially viable design process, sustainability should be seen as a priority in the education of practitioners from the beginning of their studies and through to Continuing Professional Development. This requires that academic and professional bodies, educators, students and practitioners are all fully committed to this priority, enthusing and inspiring students to rigorously and creatively address design challenges through appropriate pedagogical methods, tools and techniques, and the allocation of

adequate human, financial, and temporal resources. A successful education for sustainability should encourage critical awareness, responsibility, and reflection of the interdependencies within the design process, and support investigative discourse between different disciplines, parties and professions, continuously contributing to the evolution of knowledge through exemplar research and responsible practice. Such pedagogical processes should be supported by accrediting and regulatory bodies, also to foster the dissemination of knowledge for it to be easily accessible to students, academics, practitioners and the public. To realize such priorities, pedagogical developments should primarily build on a critical analysis of the barriers and opportunities expressed by the market to define the learning outcomes expected of graduates at pre-and post-professional level [6].

Pedagogical Objectives and Learning Outcomes

The agenda of sustainability is forcing new demands on educators, students, and professionals. For such priority to be consistently embedded in curriculum development, pedagogical objectives should build on the results of research and built practice - as well as on policies, qualification frameworks, and market demands - so as to define the learning outcomes in terms of knowledge, skills and competence in sustainability that graduates and practitioners should acquire at each level of training. The descriptors *knowledge*, *skills* and *competence* here adopted derive from the *European Qualification Framework for Lifelong Learning (EQF)* to guarantee their transferability across educational systems. Such learning outcomes have been proposed by EDUCATE at three stages, *Sensitisation*, *Validation* and *Reflection*, which could be potentially assumed to correspond to *undergraduate* (Bachelors), *graduate* (Diplomas or Masters) and *postgraduate* (Doctorates or post-professional Masters) degrees. However, such correspondence can vary basing on the structure, resources, ethos, and innovation that characterise academic institutions. In fact, two or all of these stages could be potentially condensed in one single cycle of higher or post-professional education. Hence, without defining an “ideal” model of curriculum, these stages of learning are solely intended to suggest a progression of abilities of sustainability, which students - as well as educators and practitioners - should gradually attain.

Stage 1: Sensitisation. At the first stage of education, principles and values of sustainability should be provided as an introduction to contemporary challenges and as drivers of architectural form, opening the gates of the skills needed to creatively explore design ideas. The pedagogy should aim towards the formation of a sensitive attitude in the creation of built spaces, from the pragmatic to the poetic. This should help to mitigate prejudices and biased opinions on the framework of sustainability. A pedagogy based on *learning by doing*, with investigative ‘hands-on’ coursework given at the

same time of the delivery of knowledge, can engage students in their learning, instigate commitment, passion, and enthusiasm for sustainability, and target the *sensitisation* of students towards the development of an architectural language informed by sustainable design. The learning environment should become one of cooperation, fostering a dynamic interaction in the lecture theatre as in the design studio. The pedagogy should be reinforced by field trips and illustration of case studies. Regulations should be introduced as a minimum target to meet, but also as a vehicle to trigger questions and stimulate creativity. Students should be provided with 'rules of thumb' to inform the design response and contribute to frame the feasibility of proposed solutions. Practical experiential tools could consolidated the learning and emphasise the importance of a complementary relationship with other disciplines

Stage 2: Validation. At the second stage of education, students should develop autonomy in design exploration and competence to resolve questions, researching those by appropriate techniques to yield results that can be analysed, quantitatively and qualitatively. Students should be provided with the knowledge necessary to *validate* the concepts explored, together with the abilities to propose innovative design strategies. Educational methods should be founded on *problem-based learning* so that motivation towards the framework of sustainability is triggered by the need to strengthen, combine, and develop the necessary skills to evaluate problems and propose new solutions. The teaching should be supported by exempla of best practice to provide reliable performance data and to focus personal agendas of tutors to one that adopts sustainability as core to the pedagogy. The role of design as a forum for investigation should be reinforced. Coursework should address key issues of environmental, social, and economic sustainability, to be creatively addressed in design. Simulation and verification tools should facilitate data analysis, assessment of performance and comparison of scenarios.

Stage 3: Reflection. At the third stage of education, students should be encouraged to deepen and specialise their interests, critically linking learning with its applications to professional development, and committing to cutting-edge scholarly and/or design research, individually or as a member of a multi/inter/transdisciplinary team. The range of abilities acquired at the first two stages of education should be reinforced and utilised to look at the built environment in a holistic way, also engaging with advanced training and lifelong learning. Courses could clearly differ according to their specific streaming of specialisation, therefore promoting differentiated knowledge, skills, and competence. The preferred teaching methodology should remain that of the one-to-one tutorial or the seminar, so as to support a research-based approach to design, and also promote exchanges between disciplines. The curriculum should

be reinforced by transfer of experience, knowledge, methods, and results of scholarly, practice-based, and pedagogical research between academic institutions and professional bodies, so as to also contribute to bridge the gap between higher education and the practice of design. Research as a learning and design tool should be emphasised, as well as the analysis, verification, and critical reflection on the results achieved, promoting a pedagogy based on *performance-based learning* and design research. Students need to develop reflection and originality in tackling design issues, and this could be supported by the direct analysis, measurement, simulation, and/or verification of built case studies that can inform the development of innovative ideas [6].

Programme Structure and Pedagogical Methods

An integrated cognitive framework has been proposed by EDUCATE to systematise the contents to be delivered in academic programmes, where the notions of sustainable design have been categorized under the domains of *theoretical* (issues and principles), *experiential* (applications and case studies) and *analytic* (tools). The pedagogical methods could vary, but they should build the knowledge, skills, and competence in layers, and incorporate both qualitative and quantitative information. A plurality of approaches in terms of programme structure could be adopted to accommodate such cognitive framework, in line with the teaching and learning culture and organisation of each institution. Founded on a review of academic curricula, EDUCATE has identified five models of programme structure:

- *Linear / Parallel:* Each disciplinary area runs in parallel and knowledge is delivered autonomously, with lecture modules and studio assessed independently.
- *Partially Integrated:* Modules of environmental science / design represent the link between studio and other core teachings. Although these can be taught as stand-alone units, they are - at least in part - integrated with other subjects in delivery or in assessment.
- *Fully Integrated:* Studio modules are conceived as working spaces, where delivery of contents of different domains converge around the central role of the design.
- *Iterative:* Rather than following a linear sequence of knowledge delivery and application, this structure is based on cognitive 'loops', where contents delivered at one stage inform the abilities practiced at the next.
- *Elective / Minor:* This structure is characterized by various electives that students can include in the studies.

Each programme structure has its own challenges and opportunities, so it is necessary that the pedagogy is supported by adequate methods of teaching and learning to facilitate knowledge transfer and exploration. Among the potential strategies that can enhance education for sustainability in each model are the following:

- *Develop interconnections between theoretical lectures and design studio.* This can be promoted by guest lectures and design projects that create a link

between theoretical principles and their applications, so as to foster teamwork and communication.

- *Promote a research-based, analytic and holistic approach to design.* The pedagogy should be founded on a scientific and holistic approach, where each factor is thoroughly analysed, critiqued, and evaluated.

- *Increase competence of sustainability at the various stages of the programme.* Sustainability should not be seen as a separate ‘specialism’ to be delivered as a satellite component, but rather it should be integral to the curriculum as an inspiration to the design process.

- *Promote the central position of the design studio.* A close relationship between lectures and studio should encourage critical and creative thinking, requiring a proper series of projects evolving across the curriculum.

- *Foster student-centred learning via ICTs.* E-learning can motivate learners through interaction with tutors and peers, while providing open access to didactic material and developing skills in team working [2].

PROFESSIONAL QUALIFICATION CRITERIA

To regulate and verify the knowledge, skills, and competence in sustainability expected of graduates and practitioners, EDUCATE produced a white paper on *Criteria for Professional Qualification*. Founded on the Directive 2005/36/EC, the white paper took a propositive approach in reviewing national and international legislation, so as to define strategies and priorities - illustrated in terms of *education and training towards professional qualification, regulatory frameworks and priorities for sustainable practice* - to advocate consistency in the requirements for qualification across Europe, and move closer to the practice of a sustainable design of the built environment.

Education and Training for Professional Qualification

Prescriptions for qualification seek to ensure that the standards attained by graduates are appropriate with respect to the abilities and ethical formation required for competent practice. An analysis of the international state of the art of qualification routes allows the creation of a comprehensive picture in relation to the conditions for qualification of practitioners of the built environment, leading to the identification of different models of progression to professional practice, basing on:

- Requirement for accreditation of curricula.
- Practical experience (internship during the studies).
- Professional training after graduation.
- Requisite of a professional examination.
- Regulated Continuing Professional Development.

Five paradigmatic models were identified by EDUCATE. The first model implements all the above regulated mechanisms in terms of development of knowledge, skills, and competence, as well as for the verification of the outcomes attained. In addition, this model embraces lifelong learning through compulsory

CPD. This model is internationally applied, for example, in English-speaking countries (e.g., UK, USA). The second and the third models include requirements for professional training after graduation, although not always this is considered as a compulsory prerequisite for registration. The presence of a mandatory professional exam to gain access to independent practice is the substantial difference between the second and the third model. These models are implemented in most EU countries. The fourth model doesn't require regulated internship, professional training neither an exam. Thus, this model presents limited opportunities for verifying the development of knowledge, skills and competence, and for the appraisal of the learning outcomes achieved. The fifth model is atypical with regard to higher education, as the attainment of an academic title is replaced by adequate professional experience, evaluated both in terms of its duration and its achievements (e.g., this model exists as an alternative route to qualification in countries such as Switzerland and Singapore) [2].

Regulatory Frameworks

In order to increase the flexibility of labour and encourage automatic recognition of qualifications, the European Parliament adopted in 2006 the *Directive 2005/36 on the Mutual Recognition of Professional Qualifications*. In its Article 46, the Directive defines the duration of the academic education of architects in Europe, and the knowledge and skills to be acquired.

This Directive has recently been subject to an ex-post evaluation, with the aim of exploring additional potential for mobility of qualified professionals and for a more integrated labour market. To this end, in December 2011 the European Commission published a *Proposal for a Directive of the European Parliament and of the Council amending Directive 2005/36/EC*, encompassing the following review in terms of training of architects:

- The extension of the minimum duration of full-time studies from 4 to 6 years, with the introduction of a compulsory remunerated traineeship of 1 to 2 years;
- The possibility to further specify the adequacy of the competence entailed by points (i) and (j) of Article 46 in line with current challenges. These two points deal respectively with knowledge of “*physical problems and technologies*” and of “*users’ requirements*”.

To substantiate the transferability of the learning outcomes advocated in the white paper on *Sustainable Architecture Education*; to respond to the lack of homogeneity in qualification routes; and, to modernize principles that in Directive 2005/36 are still referring to the fundamental Architects' Directive 384 of 1985 - that for more than 20 years had provided the basis for the recognition of architectural qualifications in Europe - a further proposal has been made by EDUCATE, including two additional revisions to Article 46:

- The first aimed to make more explicit the priority given to values and principles of sustainability in the

training of architects, including in Art. 46, the sentence: *'Sustainable design must be considered as an integral part of architectural training from the beginning of the study and through continuing professional development'*

- The second addressed the knowledge, skills, and competences as set out in points (i) and (j) of Article 46 of 2005/36/EC, proposing, for each, the following text:

'Art. 46 (i) - adequate knowledge of physics, technologies and functions of buildings and urban spaces so as to provide comfort and environmental qualities, indoors and outdoors;

Art. 46 (j) - the necessary design skills to meet building users' requirements within the opportunities provided by cost factors, building regulations and sustainability' [2].

Priorities for Sustainable Practice

In order to engage key actors of the building industry to implement coherent and verifiable qualification criteria towards a sustainable practice of design, a set of priorities in support of knowledge, skills, and competence in sustainability have been put forward by EDUCATE, for these to be embedded in subject benchmarking and regulations. These priorities are centred on the key steps that characterise the progression towards practice - *academic education, internship, professional training, professional examination, and, continuing professional development* - and encompass:

- A multi/inter/transdisciplinary academic education and professional training for all actors of the building market centred on the values of sustainability.

- Lifelong learning enforced by regulated Continuing Professional Development to enhance the opportunities offered by new knowledge, regulations, and initiatives.

- Integration in the practice of design of the results of research related to sustainability, as well as know-how of traditional skills, materials, and building techniques.

- Access to reliable data and benchmarks in terms of costs, performance, and evaluation of payback.

- Organisation of dissemination events, together with the production of literature, communication via the web and on-line learning, so as to allow wide access to principles and values of sustainable design, and to exempla of best practice, to expert and lay audiences.

In promoting the implementation of sustainability in the practice of design, evidently, a primary role can be played by governments and professional institutions via adequate regulatory frameworks, thus suggesting:

- The need for a top-down approach with a major governmental commitment to sustainable design.

- Reinforced communication between the design professions and regulatory (and academic) institutions.

- Clear and streamlined regulations and benchmarks supported by verification of their application.

- Legislation able to encourage design research and experimentation, and stimulate opportunities for creative architectural expression.

CONCLUSIONS

There still seems to be a lack of consensus regarding the effective impact of sustainability upon teaching and learning in programmes of higher and post-professional education. And yet, a global review of academic and professional training reveals that the agenda of sustainability sits at the core of the activities of many academic, regulatory and professional bodies [7].

Sustainability has been conceived as paradigmatic, but also as requiring a paradigm shift to be approached in an effective and meaningful way. So, does it present a golden opportunity to stimulate pedagogical reform? Or is engagement with sustainability too often tending towards a technicist approach? And how do educators and policy makers, in diverse contexts, interpret the meanings and objectives of sustainability and assess its impact upon the processes of education and training?

It would be wrong to assume that a single interpretation can be exhibited of the sustainability agenda and its impact upon the formation of building practitioners. However, it has been argued in this paper that there is value in exploring the evolution of pedagogical and regulatory responses in the effort to interrogate, interpret, and integrate the powerful concept of sustainability. Significantly, this ambition does not just involve a change in the content of current educational and qualification frameworks, but rather requires asking deep questions about what the actual purpose of education for sustainability is.

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