

# Educate!

## Sustainable Environmental Design in Architectural Education and Practice

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*ABSTRACT: Awareness of the role that buildings play in the current climate crisis is bringing to the fore new responsibilities for architectural educators and practitioners. Various pedagogical barriers still hinder the comprehensive implementation of mandates of environmental sustainability in design studio, at all levels of architectural education. Concurrently, the promotion of sustainable design in the practice of architecture and urban design is not yet consistently supported by regulatory bodies, whose qualification criteria are still frequently inhomogeneous and ambiguous, especially in ascertaining an effective integration between creative and technical skills. A substantial shift in policies and pedagogical methodologies is needed to facilitate the transfer of knowledge between sustainable sciences and building applications, and enhance the implementation of environmental sustainability within creative design. To tackle such barriers, the EU-funded project EDUCATE (Environmental Design in University Curricula and Architectural Training in Europe, 2009-2012) was built on a consortium of seven European academic partners and several professional bodies, aiming to promote the integration of sustainable environmental design in the education and practice of architecture and urban design. This paper illustrates some of the results obtained by the EDUCATE project and discusses the potential transfer of its methodologies and tools to academic and professional institutions at a global level.*

*Keywords: education, sustainability, architecture, curriculum, knowledge transfer*

### INTRODUCTION

In the context of the current climate crisis, the role of higher education as a means of introducing new generations of building practitioners to the principles and practices of sustainable environmental design is becoming highly significant, although this faces a number of pedagogical and professional barriers [1].

The need to trigger a change in pre- and post-professional education that promotes a sustainable approach to design is mainly triggered by three factors:

1. Current building practice has been relatively slow to respond to the demands of fostering environmental sustainability within a creative design discourse;
2. Accreditation and qualification criteria do not yet consistently contribute to promote knowledge, skills and competences of sustainable environmental design amongst students, graduates and practitioners;
3. Universities and regulatory bodies have shown to be sparsely effective in integrating sustainable environmental design in curricula of higher education.

The aim of this paper consists in critically analyzing the barriers to the successful integration of sustainable environmental design in academic programmes and in the practice of architecture and, consequently, recognising some of the efforts required to achieve such objective. In this context, the results of a European project, EDUCATE - set to promote the comprehensive implementation of environmental sustainability in higher and post-professional education - are presented, so as to discuss the potential impacts of its outcomes and the transfer of its methodologies and tools to academic and professional institutions at a global level.

### THE EDUCATE PROJECT

To promote sustainable environmental design in academic curricula and post-professional training, the 3-year EDUCATE (*Environmental Design in University Curricula and Architectural Training in Europe*, [www.educate-sustainability.eu](http://www.educate-sustainability.eu)) project was funded in 2009 by the European Commission's Executive Agency

for Competitiveness and Innovation (EACI) under the 'Intelligent Energy Europe' programme.

EDUCATE was built on a consortium of seven academic partners: University of Nottingham (UK, Coordinator); Architectural Association School of Architecture (UK); Catholic University of Louvain (Belgium); Technical University of Munich (Germany); Department DATA, University of Rome La Sapienza (Italy); Seminar of Architecture and Environment - SAMA (Spain); and, Budapest University of Technology and Economics (Hungary). EDUCATE also received the support of the Chambers of Architects in all participating European countries, of internationally renowned architects, of experts of cognate disciplines, and of associations of educators and practitioners.

The mission of EDUCATE was to "*foster knowledge and skills in sustainable environmental design, aiming to achieve comfort, delight, well-being and energy efficiency in new and existing buildings*". This was to "*be promoted and demonstrated within a culturally, economically and socially viable design process, at all stages of architectural education*" [2].

EDUCATE was set to achieve the following aims:

- Tackle pedagogical barriers to the integration of environmental sustainability within creative design;
- Define and test a framework for curriculum development that bridges divides between technical sustainability-related knowledge and the design studio;
- Develop an online Portal that facilitates such integration in higher and post-professional education;
- Propose clear criteria for accreditation of curricula and professional registration measuring the knowledge, skills and competence of sustainable environmental design expected of graduates and practitioners;
- Disseminate know-how and exempla of best practice amongst students, educators, building professionals and the general public.

## STATE OF THE ART

To identify existing hindrances and opportunities in integrating environmental sustainability in the training of building professionals, the EDUCATE project has initially analysed and consolidated the international state-of-the-art of curricular structures and professional requirements at a European and global level.

To this aim, partners have conducted an exhaustive analysis of the state of play of education in sustainable environmental design within architectural-related degrees, and have investigated how these relate to the conditions for accreditation of academic curricula and the requirements for professional qualification established by competent bodies in the various countries considered. This task has also included an overview of education literature and a comparison of the state of the art with contemporary pedagogical theories and practices.

A total of 70 curricula have been scrutinised from some 30 European and non-European countries. These activities have been supported by close cooperation with national professional bodies and have been accomplished via analysis of curricular structures, review of published documents (e.g., web sites, yearbooks, conference and journal papers, works of students, etc.), interviews, and direct feedback obtained from academics.

Further to this, partners have also instructed a systematisation of the criteria and procedures for professional qualification throughout Europe, whilst also acknowledging conditions and prescriptions for registration in non-European countries, so as to guarantee the transferability of the project's outcomes at a global level and also facilitate the appraisal of external inputs to be implemented at subsequent stages of the project [3].

Concurrently, partners have ascertained the level of awareness, knowledge, ability base and demands in terms of sustainable environmental design within the practice of architecture, and have benchmarked the needs and expectations of the building market.

This task was performed via an online survey where practitioners and other stakeholders were presented with a series of statements to which they had to express their opinion, respectively addressing sustainability in academic curricula, in continuing professional development and in regulations and clients' requirements. A further section of the survey gave to respondents the possibility to comment in the form of free text on the main challenges to the implementation of sustainability in professional practice. Some 400 surveys were collected from around 40 different countries [4].

As a conclusion of these activities, an 'Agenda for sustainable architectural education' was formulated, featuring ten priorities to be considered in curriculum development to enhance sustainable environmental design in the education and practice of architecture.

The outcomes of the initial stages of EDUCATE have been consolidated in two reports, encompassing the *State of the Art of Environmental Sustainability in Academic Curricula and Conditions for Registration* and the *State of the Art of Environmental Sustainability in Professional Practice*. These reports are downloadable from <http://www.educate-sustainability.eu/state-of-the-art>

## CURRICULUM DEVELOPMENT

Following the initial analysis and consolidation of the state of the art, the work of EDUCATE has concentrated on the proposition of a framework for curriculum development promoting the adoption of principles and practices of sustainable environmental design at different levels and stages of architectural education.

Multi-, inter- and trans-disciplinary contributions to pedagogical advancement have been explored, together with the appraisal of applied/experiential learning methods, new analytic visualisation tools and the

integration of up-to-date technical and didactic insights from pedagogical research. This task has also included the implementation and development of an e-learning system (EDUCATE Portal), featuring interactive methodologies for knowledge delivery and sharing.

Concurrently, partners have systematised the knowledge base of sustainable environmental design to be introduced at the different stages of a programme in architecture. The resulting framework for curriculum development has been constructed in accordance with the Bologna structure of higher education, thus proposing the progressive implementation of sustainable environmental design across 6 years of architectural education (3 years *undergraduate*, 2 years *graduate*, 1 year *postgraduate*) and within continuing professional development (CPD).

The framework has been elaborated to offer a conceptual support to curriculum development, although maintaining sufficient flexibility for it to be adaptable and adjustable to a diversity of contexts, educational methods, resources, environmental targets, etc.

A curriculum effectively promoting sustainable environmental design in architecture must by necessity be based on a clear *mission agenda*, where sustainability is seen as a priority from the beginning of the studies. This requires that academic institutions and professional bodies are all fully committed to this priority, enthusing and inspiring students to the practices of sustainability through appropriate pedagogical methods, tools and techniques, and the allocation of adequate research, human, financial and temporal resources. Education for sustainability must encourage critical awareness and reflection on the numerous interdependencies within cognitive domains and support investigative discourse between the various parties and professions involved in the building industry, continuously contributing to the evolution of knowledge through exemplar (design-based) research and responsible professional practice.

Developing a curriculum for sustainability must build on a critical analysis of the priorities required by the market, so as to define the *learning outcomes* in terms of knowledge, skills and competence expected of graduates at each stage of their progression towards qualification. To this aim, pedagogical objectives need to be related to an expanding knowledge base of sustainable environmental design, which should encompass at once *theoretical*, *empirical* and *analytic* domains. A solid conceptual background is in fact an essential requirement to provide students and practitioners with the ability of converting physical laws in creative architectural forms. This, however, has to be supported by experiential understanding and evidence-based learning - so as to appreciate how principles can be applied into practice - and by analytic tools and simulation techniques - that can facilitate the testing and evaluation of different hypotheses from the early stages of design [5].

A variety of *programme structures* could be adopted to accommodate such aims, making it unfeasible to

formulate the ‘ideal’ model of a curriculum. This, in fact, has to respond to the specific teaching culture, ethos, and organisation (e.g., staff to students’ ratio) of the institution concerned. Yet, basing on an analysis of the correlation between pedagogical areas, five paradigmatic models of programme structure can be identified (Fig.1):

- *Parallel*: disciplinary domains run separately;
- *Partially integrated*: different areas are linked in delivery or, more frequently, in assessment;
- *Fully integrated*: various disciplines converge around the central core of the design studio project;
- *Iterative*: knowledge is progressively deepened through a series of cognitive ‘loops’; and,
- *Elective*: contents are enriched by optional courses, e.g., domain-specific modules or Minor degrees.

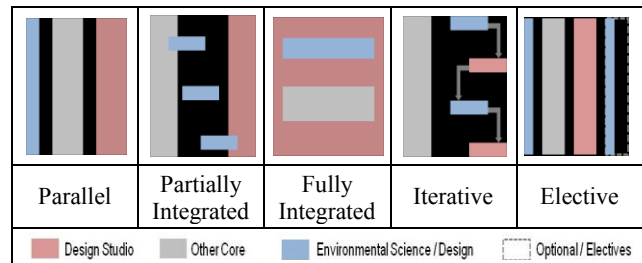


Figure 1: The five models of programme structure

Each programme structure brings its advantages and constraints, hence the pedagogy must be supported by adequate methods and techniques to facilitate knowledge transfer [6]. In this context, new teaching and learning tools derived from Information and Communication Technologies (e.g., e-learning) have been proven to offer significant opportunities to encourage self-reflection, deep learning and critical understanding, and promote multidisciplinary collaboration - fundamental skills to an integrated education in architecture. To this aim, the development of the EDUCATE Portal has represented an essential tool for the achievement of the pedagogical objectives of the project, as well as a fundamental instrument to accomplish its proposed long-term impacts.

The *Framework for Curriculum Development* report is available for download on <http://www.educate-sustainability.eu/educate-framework>

## THE EDUCATE PORTAL

The vision for the EDUCATE Portal was to create an online, interactive and intelligent e-learning system that facilitates the transfer of information, knowledge, best practice, results and methodologies, so as to provide interactive support to students and practitioners, and reinforce an integrated approach towards the embracement of principles of sustainability and energy efficiency in the education and practice of architecture.

Where possible, use has been made of existing software and components (for example, the Drupal Content Management System). However, no existing

system (or combination of systems) could support the functional requirements of the EDUCATE Portal, thus significant development of new bespoke software has been necessary to implement its structure.

The EDUCATE Portal has been designed to offer the following functionalities: *Knowledge Base*; *Reading Lists*; *Discussion Forum*; *Knowledge Base Questions*; *Frequently Asked Questions*; *Studio Space*:

*Knowledge Base* - The publicly accessible online Knowledge Base (KB) represents the collected expertise of the consortium partners in key concepts of sustainable environmental design (<https://www.educate-sustainability.eu/kb>). The KB has been structured in three parts: *Issues and Principles*, *Applications and Case Studies*, and *Tools*. Each of the three parts is organised in a primary ‘ontology’ - generally subdivided in categories and clusters - which forms a key element of content retrieval. Each cluster groups a related set of topics, case studies and practical resources. The material relating to each topic, case study and tool, is presented in the form of five aspects or ‘tabs’, which offer different views on the contents (Fig. 2). The Knowledge Base is not limited to a tree structure (i.e., sections and subsections), but rather it features several ‘horizontal’ links between contents in its different parts, and makes use of links to external references and websites where appropriate.

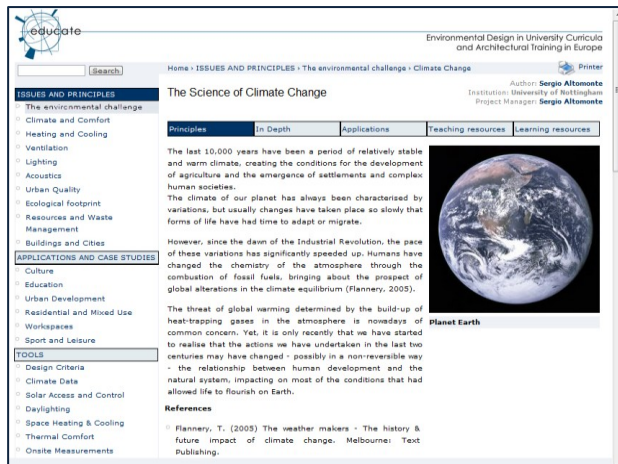


Figure 2: A snapshot of the EDUCATE Knowledge Base

*Reading Lists* - In order to help students find information concerning a specific topic, case study or tool, an instructor at any of the partner institutions can create a reading list consisting of an ordered, annotated set of links to the KB that are relevant to a coursework or design project, and which form part of the background material for a module. Each student is able to access all the reading lists set up by each partner, so as to foster exchange of pedagogical methods and contents.

*Discussion Forum* - The discussion forum supports interaction between groups of users (e.g., academics, students, and professionals), where comments, posts, information, data, links to relevant websites, etc. can be

posted and shared with other users. Depending on institutional and course-specific settings, discussion forums can be accessible from all registered users, from students from a specific university, or can be limited to a group of students (e.g., enrolled in a single module).

*Knowledge Base Questions* - Students can ask a question about a specific KB content directly on the Portal, which is answered by an appropriate expert from within the consortium. The question and the answer may or may not be visible to other users in the same module / studio group, at the discretion of the expert. The expert may decide to make a question and an answer public to all students (also only from their institution), by transferring them to the Frequently Asked Questions.

*Frequently Asked Questions* - The FAQs provide answers to frequently asked questions on contents featured in the KB. The FAQs are grouped into category of interest, following the same structure of the KB.

*Studio Space* - This functionality has been designed to support the development and assessment of design studio work. Students enrolled in a specific studio may be required to upload work for interim assessment a number of times during a project. Each student can create folders containing their uploaded work. Folders can be accessible only by the student and the tutor, or by other members of the student’s studio or group, depending on the organisation of the design tasks. If required by the institution and/or their module pedagogy, students can also have access to work of other students to provide peer feedback. The degree of access can be configured to meet the needs of the particular project/group/institution and the stage of the work (interim or final). Access to interim work is typically limited to the tutor, whilst access to finalized work can be wider.

A detailed description of the various functionalities of the EDUCATE Portal, the results and feedback obtained in its testing phases, and the source code for the Portal, are all available for download from <http://www.educate-sustainability.eu/portal-development>

## TESTING OF THE PEDAGOGY

Following the adoption of the framework for curriculum development at participating institutions, partners have engaged in testing various pedagogical practices and measuring their success in terms of promotion of environmental sustainability within design studio.

The testing has been structured in a series of stages. Initially, the proposed framework has been compared to current educational practices at participating institutions and has been ratified by the national Chambers of Architects against their accreditation and qualification criteria. Subsequently, new and/or adapted course and module syllabi have been developed by partners. At this stage, a *Pilot Study* of 5 months duration (February to July 2011) has been launched to test the pedagogy devised and measure the effectiveness of the teaching

and learning features provided by the EDUCATE Portal. In collaboration with regulatory bodies, building professionals have also simultaneously been invited to trial the use of the Portal to support CPD activities.

The results of the Pilot Study have led to further refinement of the pedagogical developments devised by partners, and have informed the subsequent 4-month stage of analysis, the *Field Testing* (September to December 2011). During both testing phases, secure access provided to staff, students and practitioners to the EDUCATE Portal has constituted a fundamental tool to enhance the success of the pedagogy. The number of users involved in the testing has been consistent with current practices of studio teaching. Specifically, 1,580 individual accounts on the EDUCATE Portal have been provided to academics, students and professionals affiliated with partner organisations [7]. Different user groups have been provided with features tailored to the pedagogical practices at each institution.

Students across partner organisations have accessed technical information directly on the Portal, completed assignments, presented their work, got feedback on their design progress and reviewed the work of others. The Portal has also disseminated knowledge, guidelines, exemplary work, best practice, etc., thus creating an online network facilitating a wide transfer of information, results and methodologies. A survey was distributed to all the EDUCATE Portal users at the end of each testing phase so as to measure its effectiveness in supporting teaching and learning of sustainability.

The briefs developed at each partner institution, and the results obtained in the testing, are illustrated in detail in the publication *Results of Course and Curriculum Development* available on <http://www.educate-sustainability.eu/results-of-development>

## EDUCATE PRIZE

In the context of the testing of course and curriculum developments, an International Student Award - under the banner of EDUCATE Prize - was launched in July 2011, to which staff and students from all partners, as well as from other European and non-European academic organisations, have been invited to participate.

The EDUCATE Prize primarily aimed to celebrate outstanding student work that creatively investigates and reflects on the various dimensions of sustainability in architecture and urban design. The Prize was also conceived to reward original and innovative ideas and pedagogical methods promoting sustainable principles and practices in curricula of higher education.

The international character of the EDUCATE Prize, the free choice of the themes analysed by the submitted proposals (i.e., the brief did not prescribe a precise site or design programme), and the diversification between different levels of entry, have been arranged to reflect the flexibility, autonomy, individuality, cultural diversity and

innovation of approaches that characterise contemporary architectural education. The EDUCATE Prize has been structured under three different Categories:

- Category I: Student design projects (Years of study 1-3, Undergraduate Degrees);
- Category II: Student design projects (Years of study 4-6, Graduate and Postgraduate Degrees),
- Category III: Open student work (non-building design projects, such as videos, collages, etc.).

Awards ranged from € 200 to € 1,000 for each Category. Academic members of staff from Faculties, Schools and Departments of Architecture (or related discipline) worldwide were eligible to register their module, course or design studio to the EDUCATE Prize and submit maximum one entry under each Category. Academics registering to the Prize were also given free use for themselves and their students of the EDUCATE Knowledge Base (still under secure-access at this stage), so as to support dissemination of knowledge of sustainability in the development of the projects.

By the set deadline (9<sup>th</sup> December 2011), 122 academics registered to the EDUCATE Prize in representation of 64 Universities worldwide (48 Universities from Europe, 6 from North America, 5 from Asia, 2 from South America, 2 from Australia and 1 from Africa). 387 new users (tutors and students) were given free access to the EDUCATE Knowledge Base. 86 entries under the 3 Categories of the EDUCATE Prize were received from 42 different Universities (34 Universities from Europe, 2 from the United States, 2 from Chile, 1 from Canada, 1 from Bangladesh, 1 from Singapore, and 1 from Malaysia).

Under the coordination of the Bavarian Chamber of Architects (Germany), the assessment process involved an independent Jury composed by members of European professional institutions and international architects. Assessment criteria have been primarily based on the technical and theoretical contents featured in the online EDUCATE Knowledge Base. The pedagogical methods, teaching and learning processes, methodologies for supporting the design development, capacity of critical reflection and awareness of sustainable mandates demonstrated by the author(s) of the entries were also highly regarded amongst the judgment criteria.

The Award Ceremony and exhibition was held in Rome (Italy) on the 23<sup>rd</sup> February 2012 in the context of a Symposium on Education for Sustainability with international speakers. Further information and a presentation of all the awarded projects is available on <http://www.educate-sustainability.eu/prize>

## WHITE PAPERS

The results obtained throughout the three years of development of EDUCATE have informed, in its final stage, the formulation of principles for sustainable

architectural education and the proposal of clear and consistent criteria for professional qualification.

To this aim, partners have primarily appraised and validated the results obtained during the testing, whilst also acknowledging feedback from relevant stakeholders (e.g., external examination boards) in order to improve and refine the pedagogical developments proposed.

The outputs of these activities have been consolidated in the production of a white paper on *Sustainable Architectural Education*, which presents a series of pedagogical principles and practices - illustrated in terms of *mission agenda*, *learning outcomes*, *programme structure*, *methods for teaching and learning*, and *strategies for transfer of pedagogy* - to foster the implementation of sustainable environmental design at different stages of architectural education. Far from advocating the standardisation of pedagogies in higher education - and thus supporting the requirement for independence and originality in academic and post-professional training in the disciplines of the built environment - these principles and practices are solely intended to provide methodological lines for curriculum and course development towards the embracement of environmental sustainability in architectural education.

Concurrently, working in tandem with Chambers of Architects, partners have ascertained the level of *knowledge*, *skills* and *competence* acquired by students and graduates under the pedagogical developments analysed within the testing, and have compared these against current criteria for professional qualification. To further measure the capacity of higher education programmes to respond to market demands, partners have also scrutinised the results of the CPD trials conducted with building practitioners, also gathering feedback from architects and professional associations. The abilities demonstrated by students and practitioners during the testing have also been measured in response to current energy regulations and building codes.

As a result, a white paper on *Criteria for Professional Qualification* has been formulated, proposing strategies for the development of consistent conditions for accreditation of architectural curricula and criteria for professional registration, informed by the imperatives of sustainability. Strategies and criteria have been formulated in accordance with (and complementing) the Directive 2005/36/EC of the European Parliament on the mutual recognition of professional qualifications across EU member states, yet still allowing some flexibility for them to be potentially embraced by regulatory bodies in different countries. The two white papers - available on <http://www.educate-sustainability.eu/white-papers> - are being disseminated so as to encourage the transfer of the results of EDUCATE to schools of architecture and professional institutions worldwide.

## CONCLUSION

To respond to the challenges of climate change, the building industry nowadays demands graduates and practitioners of disciplines of the built environment able to face a range of integrated challenges that include, other than creative abilities, also competence of sustainable environmental design. For this to take place, a process of revision of higher education and professional training is needed, so as to guarantee that the promotion of sustainable environmental design sits at the core of academic and post-professional education towards a responsible practice of architecture.

Initiatives such as the EDUCATE project testify of the growing appreciation of the need to emphasise collaboration between higher education and regulatory institutions, and reiterate the requirement for a holistic approach in the training of building practitioners, where design is not only seen as a creative problem-solving exercise, but where analytic skills, cross-referencing, imaginative reconstruction and independent thinking can form the basis of a restructured architectural culture, fostering meaningful dialogue across seemingly distant fields of knowledge and specialised expertise [8].

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