

# Applications and developments of blended learning course Ecology in Architectural Design

P. Caputo<sup>1</sup>, W. Weber<sup>2</sup>, P. Haefeli<sup>2</sup> and I. Rega<sup>3</sup>

<sup>1</sup>Accademia di Architettura di Mendrisio, Mendrisio, Switzerland

<sup>2</sup>CUEPE, Université de Genève, Genève, Switzerland

<sup>3</sup>eLab, Università della Svizzera Italiana, Lugano, Switzerland

**ABSTRACT:** EAD is a project with the main aim of developing a blended learning course about how to integrate ecology in the architectural design, both at the level of a single building and of urban landscape. EAD is a project that integrates Swiss Universities, laboratories and tertiary level technical schools with expertise in architecture, energy, ecology, technology, design and communication; the main target are students in architecture. All the contents are in English, while part of it has been also translated in the mother tongues of partners and users. EAD has been used since last academic year for testing the effectiveness of the implemented tools and for analyzing the applications results in order to optimize the overall structure and contents. Then, in the present a.y., didactical experiences with EAD have been carried out in Accademia di Architettura of Mendrisio, in Université de Genève and in Universidade de Brasília (BR). Results of the applications are very positive and encourage partners to complete the project, to improve EAD and to explore new uses not only among all the institutions involved but also involving other external institutions.

Keywords: Ecology, Architecture, eLearning

## 1. INTRODUCTION

The importance of environment and climate in architecture has been known since many centuries and fortunately, in the last years, due to the increasing importance of concepts as sustainable development, fossil fuels limitation, climate change etc, there is an increasing consideration of this theme. In fact, recently, new low energy technologies, renewable energies integration and bioclimatic approach applications are very often associated to design and planning. This trend involves economy, society, policy, technologies and, of course, the "actors" of architecture design.

On the other hand, nowadays, the terms "ecological, sustainable, green" have become synonymous of "fashionable" and there are many examples of buildings defined "sustainable", without actual sustainable features and performances [1] [2].

One reason of this misunderstanding could be imputed also to a cultural and educational lack: the relationship between environment and design cannot be condensed in a book (other tools are needed); and usually, "ecological" aspects are not yet well integrated in the design laboratories of architecture and technological faculties and schools; but new didactic approaches and educational tools, now available, could be helpful to that purpose. EAD (Ecology in Architecture Design) is a blended learning [3] project that represent a model to promote an advanced educational path for sustainable architecture.

## 2. EAD DEVELOPERS AND PROMOTERS

The project benefits from funding allocated by the Swiss University Conference within the Swiss Virtual Campus (SVC), the national programme studying the introduction of information and communication technologies in universities and universities of applied sciences. The project is run by the Accademia di Architettura of Mendrisio, in association with the Centre Universitaire d'Etude des Problèmes de l'Energie (CUEPE) of the Université de Genève, the Hochschule für Technik und Architektur (HTA) of Fachhochschule Zentralschweiz (FHZ) of Luzern and Laboratory of Energy, Ecology and Economy (LEEE) of the Architecture, Construction and Design Department (DACD) of SUPSI of Lugano. The eLab (the eLearning laboratory of USI and SUPSI) guarantees assistance and technical support for educational and graphic design and technology [4] [5].

## 3. AIMS, STRUCTURE AND PROTOTYPING

### 3.1 Aims

Main aim is to develop a blended learning course about how to integrate ecological contents in the architectural design, both at the level of a single building and of urban landscape [1] [4]. At the end of the course, students would be able to integrate autonomously ecological considerations into a given project, to understand the consequences of different

choices and to evaluate alternatives, in order to optimize the project.

The aim of the course is not only to analyze the ecological implications of buildings construction, but also to give to the next generation of architects the skills to include these components in their professional activity.

Thanks to eLearning, students will experience directly the case studies (through audiovisual guided tours) and, will test the impact of different architectural choices on energy, air, and water fluxes, as well as on the human environment, through exercises and simulations.

### 3.2 Structure

EAD is organized in two main sections: building and landscape; each section is structured in 6 modules: climate, ground, air, water, energy and population [1] [4]. The first section is related to the construction of buildings and includes the analysis and planning of the material and energy fluxes in a building, as well as its integration in the social and natural environment. The second section is related to the construction of urbanized landscape and includes the analysis of the material and energy fluxes in an urbanized landscape, including consideration of the social, political and legal themes linked to landscape. The overall structure, the module organization and the components of a module are represented in figure 1.

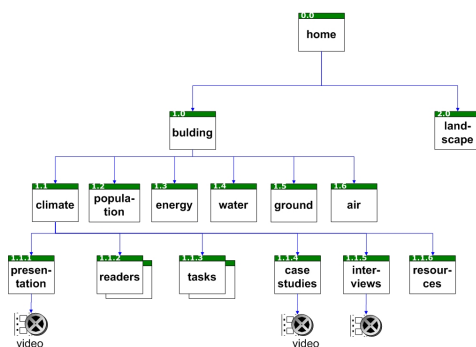


Figure 1: Structure of the EAD, modules and elements of each module

### 3.3 Prototype

The EAD project has been developed following a fast prototyping approach [3] [5]. For this reason, after the intense first phase of design and development, a first prototype of the module Building\_Climate (figure 2) has been tested in Accademia di Architettura of Mendrisio and feedbacks from partners and students have been gathered.

The module Building\_Climate contains the elements and the tools for understanding the importance of the climate-building relationship and for integrating the climatic aspects in building design. The readers, that have as references "basic mile stones" of the related literature, have been created as hypertext, with representative images (useful for memorizing), links to external web-pages, attached files for studying in depth subjects and tests for an

immediate verification of the level of comprehension [5].

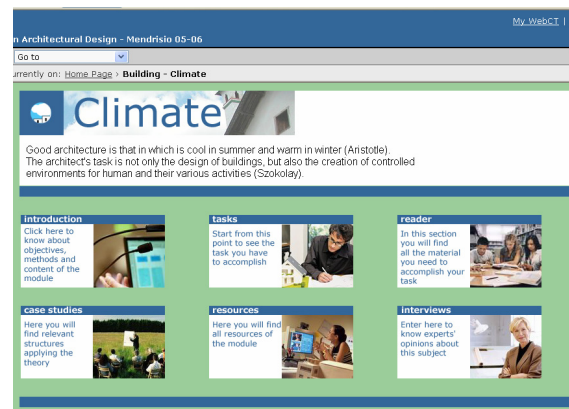


Figure 2: Updated home page of Building\_Climate module

Other useful tools are interviews to experts and audio-visual tours of case studies. Also the use of tests and external sources is very effective, but the pivotal element of the module is the task (figure 3): a task represents an activity which students have to accomplish after the deep comprehension of all the contents.

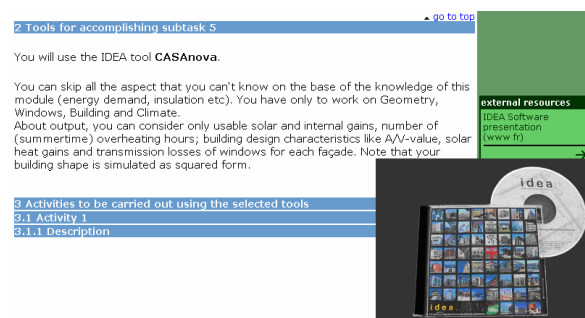


Figure 3: Building\_Climate module, example of task

### 3.4 Test of the prototype

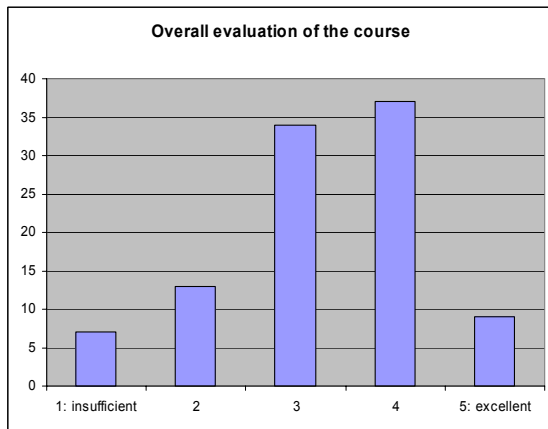
Then, after defining a pedagogical scenario, the module Building\_Climate was tested in Accademia di Architettura, from October to December 2004, in the course of *Technology – Building Physics*, with 112 student at first year [1][5].

Results of the evaluation during the test phase of the prototype module have been registered by assignments and assessments records. Students received good overall marks (about 7/9) in terms of comprehension and practical usage of the all tools.

### 3.5 Questionnaire

At the end of the test of the prototype, a questionnaire has been distributed to the 112 students attending the course in order to obtain feedbacks to refine the prototype. 74 students filled in the questionnaire, which tested the following main areas: demographics; technological issues; contents, tools and structure; graphic aspects. Overall, the course quality was judged quite positively, and the

team is satisfied, considering that this was the first eLearning experience for most of the students and the first release of the course (figure 4) [5].



**Figure 4:** Overall evaluation after the test of the prototype

### 3.6 Development of the other modules

The results of the use of the prototype and of the questionnaire sent to students demonstrated the effectiveness of EAD and encouraged all the partners to go on with the project development.

Then, partners optimized the basic structure of the modules and implemented, on that basis, the other modules. After other meetings and exchanges, they refined EAD contents and tools. Further, partners planned different levels of EAD use in year 05-06.

## 4. APPLICATIONS DURING A.Y. 2005-2006

Some modules of EAD have been integrated in academic curricula during the present academic year, as described below.

### 4.1 Accademia di Architettura

In Mendrisio, a dedicated optional course has been created: *Ecology Applied to the Project*, in which a direct integration of *ex cathedra* contents in *atelier* activities has been planned. About 40 students, at third and fourth year, have experienced EAD tools in an autonomous way: modules that are needed for accomplishing the assigned tasks were presented, then, after the enrolments to EAD, students could use contents and tools for giving good environmental performances to their projects. At the moment, due to the different themes of atelier activities, following modules have been selected: Climate, Energy both at building and landscape levels; in addition, for some students, also Water and Population (both at building and landscape levels) have been suggested.

The results of this use will be presented at the end of the second semester (July 2006), at the final examination.

Further, students will have the possibility of integrating EAD with contents edited by their own such as their *atelier* projects (that could be uploaded

as case studies) and virtual tours in buildings (elaborated with the help of external students in informatics sciences of Politecnico of Como). This aspect contributes to build a database of "best practices" for future students.

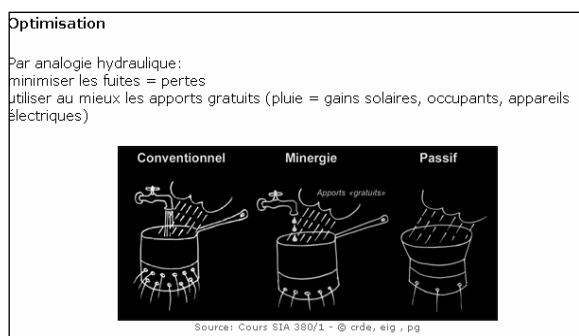
Furthermore, in the first semester, another successful experience was done, when some tools of EAD (software) were used in all projects created by the students at the third year, in the framework of *Horizontal Atelier of Ecology of the House*, with the scopes of integrating building's energy demand analysis and of giving a better understanding of links between energy demand and construction characteristics of buildings.

These and other occasional experiences omitted in this paper are important signals of several moments of communication among different teachers and students thanks to EAD introduction.

### 4.2 Université de Genève

In Geneva, Climate (version in English language) and Energy (version in French language) modules of EAD has been successfully integrated in Building's physics and Energy courses, during the first semester.

In this case, EAD tools and contents have been used beside traditional materials and software provided by CUEPE. This experience represents the most customized used of EAD (figure 5).



**Figure 5:** Building\_Energy, image from tasks, French version

Also in this case, a questionnaire to evaluate the experience has been distributed to students. The questionnaire was divided in 5 parts: profile of the student; use of the course digital materials; communication; impact and evaluation. In general, students have been happy of the experience that was for many of them the first one in eLearning.

Even if some problems have been noticed in regards to the language, because students are generally used to have tools in their mother tongue (and this is one of the reasons why energy modules were firstly prepared by CUEPE in French), also this experience could be evaluated as profitable in term of know-how transfer.

Furthermore, for a better sharing of Energy modules among the other partners, in parallel to the translation of Energy modules from French to English by CUEPE (as requested by the approved proposal), also a translation from French to Italian has been

done (figure 6), with the help of external students of the University of Aosta doing an internship at eLab.



Figure 6: Building\_Energy, presentation of tasks, version in Italian

#### 4.3 Universidade de Brasilia

The involvement of Brasilia was very peculiar; firstly, Brasilia was involved in EAD for the preparation of an important case study to be inserted in Landscape\_Population module (figure 7).

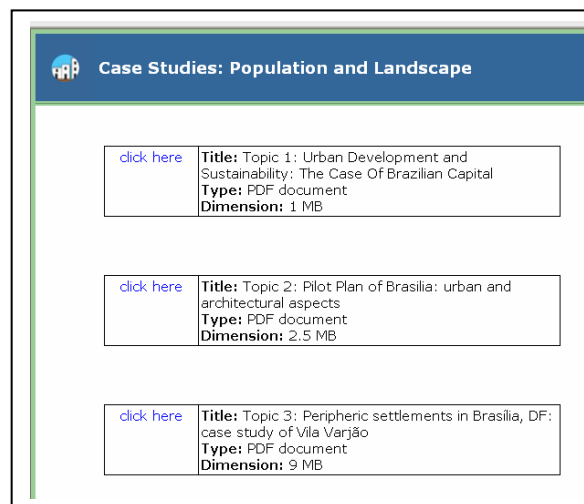


Figure 7: Landscape\_Population, case study of Brasilia

Then, due to the understating created with the leadership of EAD, Brasilia was involved also for testing usage of EAD. So, a test was done with 12 students of the Master Course in Architecture and Urbanism, from August 2005 to December 2005. In this case, Building\_Climate and Building\_Energy modules have been used as support for the class and extra-class activities. Then, some tools of EAD have been experienced also by 33 students of the Graduation Course, in the framework of the course of Thermal Comfort in Buildings.

Also in this case, we can assert that EAD had a great impact and students were very interested and very well impressed with the high quality of the tools and contents, despite of some technical problems. It has to be underlined that learning conditions in Brazil are very different from Europe and Switzerland and in

terms of tools and resources availability, of teaching conditions and so on. Therefore, this synergy represents also a real attempt in the direction of cooperation and knowledge transfer.

## 5. FURTHER DEVELOPMENTS

Partners are now engaged in completing and refining EAD materials, taking into account feedbacks provided by users, and in planning their didactical scenarios for next year. In fact, in the future, EAD will be used and maintained in all the institutions involved as partners of the project. Moreover, because SVC\_EAD project will officially end in July 2006, partners are elaborating a protocol for defining technical maintenance, further improvements, uses and developments.

We can image that future uses of EAD could be different among the partners; for example, in the Italian part of Switzerland (Accademia and SUPSI) EAD would be used at several levels as sharing and connecting platform for all Ecology's courses. This kind of use could potentially improve EAD and could promote the opportunity to present ecological themes at the first years of the curriculum for learning environmental issues; at the last years for integrating environmental issues in design activities (with more consciousness), for verifying project choices and for giving gross evaluation of environmental performance of the project; and also during diploma activities with similar aims and for updating knowledge about particular issues to be included in the project (with a more professional approach). In this case, the platform could work also as shared repository of projects elaborated by students, making available a broad collection of tools, promoting exchanges among teachers, students, tutors and external experts and developing a cooperative approach in problem solving during project design. To that end, SUPSI, that at the beginning of the project was a user partner, has now been engaged to define modes for fitting EAD to their courses of Ecology, and for complementing tools and materials. This process started considering that SUPSI has a more building-centred approach (technological and practical aspect of simple buildings are very important) while Accademia has a more landscape-centred approach (the concept of a building, also very complex, and the management of a landscape are very important) and this collaboration could promote the actual creation of a common, shared and synergic approach.

In the German part of Switzerland, the use of EAD, which will start in the next a.y., will include an active participation of students for completing case studies sections of Ground and Air modules with reports of practical technological realizations.

In the French part of Switzerland, the use of EAD will continue as in the present a.y. and updating tools, especially software for energy analysis of buildings, in which CUEPE has a well recognised know how.

Further, getting around premature information, we can assert that the possibility of accepting new partners is foreseen, after that the entry conditions for each new partner were negotiated by the original partners. For example, in the next future, an

agreement could be defined with Universidade de Brasilia for a better integration of EAD into academic curricula, with the main aims of the translation in Portuguese of the most suitable modules, of the improving of some contents, of the creation of new disciplines both in the Graduation Course and Specialization Course based on EAD. Another agreement could be defined with Politecnico di Milano, Faculty of Environmental Architecture, which would participate mainly in terms of in-kind contributions such as translations and new contents or of financial contributions for maintenance. In the case of Milan, the development of a more project-oriented approach could be implemented: the structure of EAD could be customized on the basis of the design process, using the contents and tools more for understanding how to start and elaborate *ex novo* the project of a building or of an area, than for verifying and for evaluating it. This concept is very hard because represents a further step in the direction of giving virtual tools for a very real activity: that is to design.

## 6. CONCLUSIONS

EAD represents not only a successful experience of integration of ecological issues in courses of architecture and of *ex cathedra* knowledge in design activities, but also a very effective instrument for the creation of a common didactical platform in the same academic institution and among different academic institutions. Because the possibilities of improving, updating, customizing and sharing materials and tools are very wide, further applications and developments will follow, with domino effect caused by number of institutions and number of students involved.

Starting from the idea that teachers have an important responsibility in transfer scientific ecological consciousness to students in architecture (next architects, we hope that our efforts will be useful for developing a new more environmentally conscious generation of architects, endowed with the necessary tools for the comprehension of the environmental effects of their projects, for improving energy performance of their buildings, for planning and managing landscapes with a real sustainable approach. For these reasons, external contributions and exchanges are welcome.

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