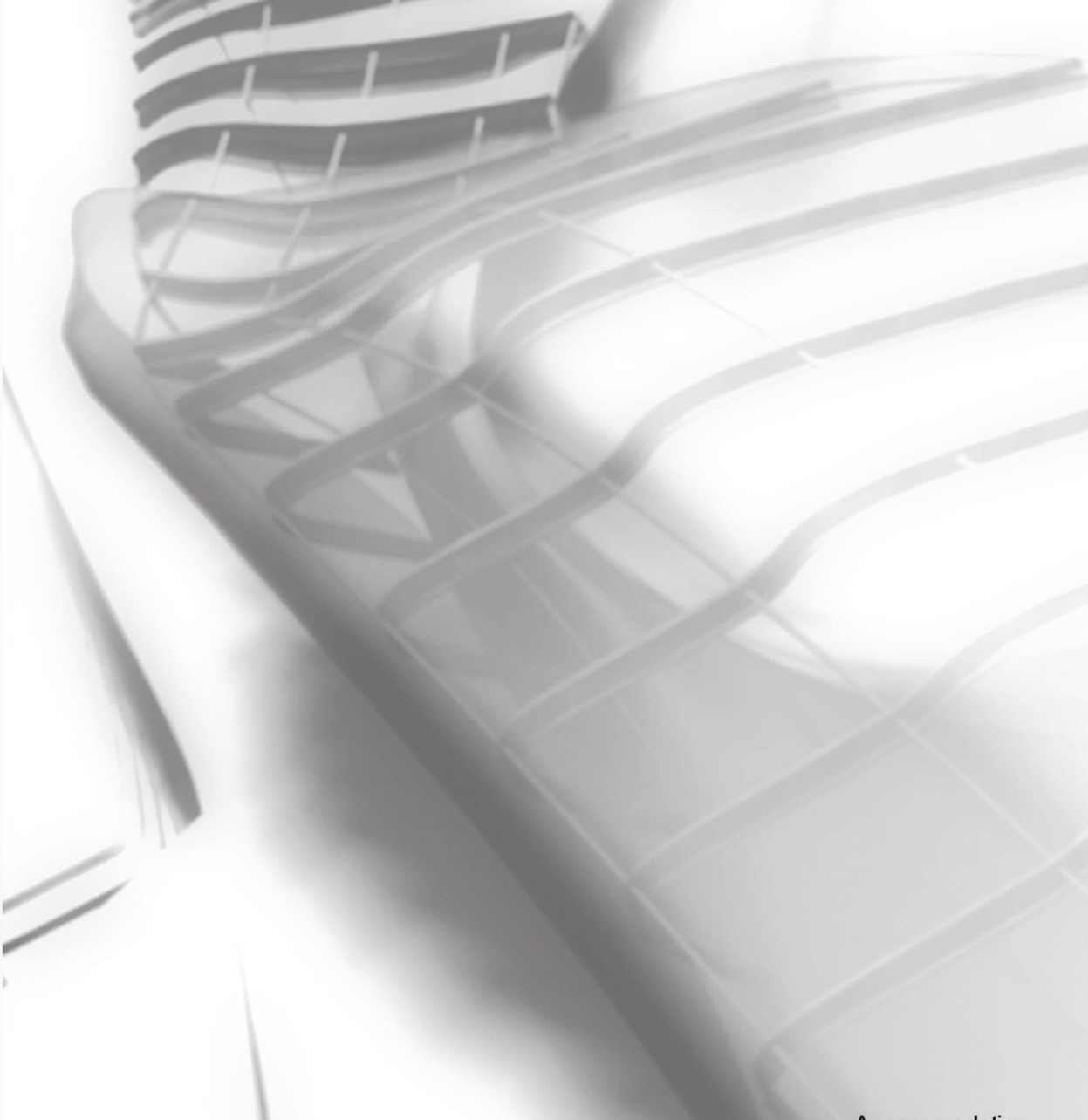

Accommodating

New Aspects of Interdisciplinarity

in Contemporary Construction Teaching

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Interdisciplinarity -
representation –
construction –
construction pedagogy

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Interdisciplinarity –
simulation/environmental control –
construction –
construction pedagogy

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Interdisciplinarity –
morphogenesis –
construction –
construction pedagogy

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Interdisciplinarity –
new material(isation) –
construction –
construction pedagogy:

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no 34

editor:
Maria Voyatzaki

enhsa european network of heads of schools of architecture
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Socrates

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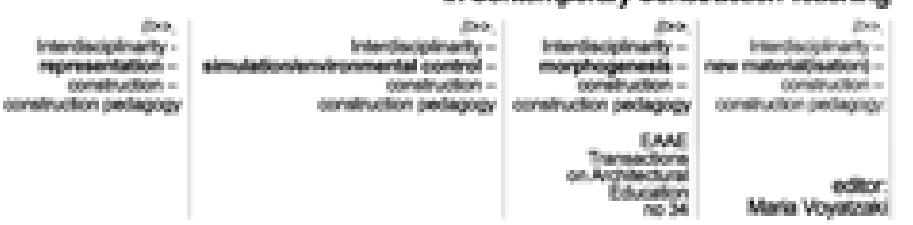

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EAAE-ENHSA Construction Teachers' Network Coordinator, Project Organiser
Dr. Maria Voyatzaki
As. Professor, School of Architecture, Aristotle University of Thessaloniki, Greece

Editor
Dr. Maria Voyatzaki

Transcription and speech adaptation: Laura Koniordos, Janet Koniordos

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Vittorio Spigai
Massimiliano Condotta

Collaborative e-learning in Engineering and Architecture: On-line Design Laboratories

University IUAV,
Venice,
Italy

Introduction

The contribution we are going to tackle in this paper is about a research, and its results, carried out from 2000 to 2006 by the research group, working at the Faculty of Architecture of Venice lead by prof. Vittorio Spigai and its associates. The subjects and the topics dealt with in this essay focus on the transmission of knowledge in Architecture teaching (characterized by a blend of different disciplines and by an high level of multidisciplinarity), and on a telematic system for e-learning in architecture.

Four years experience in collaborative e-learning, where practice, experience and developing process, constitute the scientific starting point of the research work that will be illustrated in the following paragraphs.

As a whole, nevertheless, this research is directed to the following sections:

- Protocol analysis for knowledge development sharing.
  The study and the development of monitoring systems and protocol analysis of generative processes of the project. Recording and description of the flow of typical and significant concepts that are at the base of the solutions operated by expert teachers. Every flow is connected to a particular problem or objective. Every flow contains in its development multiple references to relevant cases and concepts. This representation can be used as a foundation for comparison and as an element of reference in the valuation of the flow of projects effectively used by students.

- Collaborative e-learning.
  The study and the development of e-learning for those disciplines that largely use the technique of "*learning by doing*"[1], the construction of virtual environments with student-teacher interaction, to sum up a system that works as a *"virtual atelier"* where share and store all the practice exercises (the student's tasks and relating teacher's annotation and correction) and where link and relate the whole of the notions grown in this e-learning system with the student's tasks and with the galaxies of theoretical and documentary information which orbit in the web.

Scientific Starting Point

The transmission of knowledge in architecture: a blent of various teaching methods and multidisciplinarity.

The research started studying the peculiarity of the knowledge transmission in architecture teaching, since we think that differently from no applied disciplines, in architecture there is a low level of knowledge transmission by traditional teaching methods, instead there is a high level of knowledge transmission with the *"learning by doing"* methodology.

It is well-known, in fact, that students in such fields of study, and in particular in architecture, learn by means of continuous interaction between theoretical knowledge (from lessons) and concepts acquired through examples and advice from experts, and especially through practice on the field (guided with the teacher and/or technical experts).

The main reason behind this different receptivity of the architectural discipline is that even today the didactic transfer methods of theories and design remain assigned principally to a visual-oral tradition (conference with projected images) to practice in the studio (exercises, ex tempore, and workshop) and mainly to the periodically correction of the student's tasks (executed by students individually or in a group at home) by the teachers, correction done one by one but attended by the whole class, in fact, this is one of the most important didactic moment in the teaching of architectural design.

It is easy to affirm that all these transfer methods of the know how of architecture have great difficulty in being established in a unified and shared body of ideas.

In fact, the architectural design creates a moment of great effort of synthesis, in which various knowledge tied to artistic-poetic inclinations (ideas, social and cultural messages of the project) as well as to technical inclinations (functionality, constructibility) but also to knowledge of the different levels of the project (from urban responsibilities, to the choice of materials, of details, of components produced by the industry) are gathered to merge simultaneously since the first layout on the drawing board.

The collaboration and the sharing are afterwards, among the cluster of the knowledge transmission feature, very important and in this field the input of the computing and information technology can be significant. To do this it is necessary to find a way to monitor the multiple experiences and the activity that normally takes place in a didactic room, to record this activity, to select it, use it and make it beneficial in an expert system capable of assisting and monitoring the multiple experiences.

The peculiarity of teaching in applied disciplines resides greatly in the physical support of the student-teacher interaction, which consists of scripts, prototypes, handmade products, or presentations produced by the individual student.

In architecture, the presentation generally consists in an illustrated paper/composition and this composition, marked with suggestions, annotations and notes from the instructor, represents an inalienable moment of synthesis in the teaching and is a very powerful didactic instrument.

Why Teledidactic in Architecture?

It is generally admitted that e-learning represents one of the future universities' opportunities. It could be an essential means for some students categories (workers, invalids, ...etc.) and, furthermore, even today, it may be an important complementary aid instrument to the traditional didactic; but since the previous analysis drops hints, other important opportunities are involved.

The study and the analysis of the knowledge transmission in architecture stressed on the waste of the didactic experience grown in the atelier activity. In fact in the *"learning by doing"* methodology, that is usually played in the atelier activity, a big amount of learning is entrusted to practical exercises conducted with various methods and instruments according to the discipline, characterized by the constant commit-

ment of large amounts of time and energy to every single student to develop his/her personal, individual and specific preparation. Such accumulation of didactic experience generally gets burnt into the training of only a single student.

Teledidactic could be an opportunity to solve this problem and to turn this intrinsic anomaly into an added value, making possible to institute, through a *virtual class*, a permanent exchange community between learner and teachers, and make possible to consult in real time and to record in a knowledge system the collaboration carried out at the design table, collaboration that represents the most demanding didactic work for teachers and students.

To achieve these objective we started to develop a new teaching method based on a telematic system able to:

- reproduce this complex learning process by a distant learning web based teaching system;
- record the knowledge produced in an architectural course and make it reusable in a system capable of share the experiences of the single to all the students of the class and assist the teaching process.

The Virtual Atelier

Storage and sharing of the didactic experience

The educational development passes inevitably through communication of knowledge and operative know how with a relevant flow of ideas and abilities from the expert (teacher) to the student. The complex path of reception and view of papers and their corrections, needs constant references to previous experiences, experimental cases, etc.

The critical interiorization of the ensemble of stratagems carried out is the foundation on which one builds the cultural and technical knowledge of the student. We know that this process is widely destructured and left up to the practice and experience of the teacher. On the other hand, the new interest towards economies of scale caused by the introduction of teaching at a distance in all sectors of education, points out the problem of analyzing and rationalizing these cognitive processes that traditionally happen only in presence.

In such direction, from 2000-2006 the activity of the research group of Venice focused on the following: the construction of an e-learning system based on the idea of a *"virtual atelier"* intended to be used both as a didactic environment *(virtual class)* and as an instruments of student-teacher dialogue for a practice of revision at a distance of the student's design task and papers (Fig. 1).

This system of revision at a distance (the TDraw[2] system evolved since 2006 in the new and current version named T-Labs[3]) has been the first operative experiment of exercises online in Italy in the Department of Architecture.

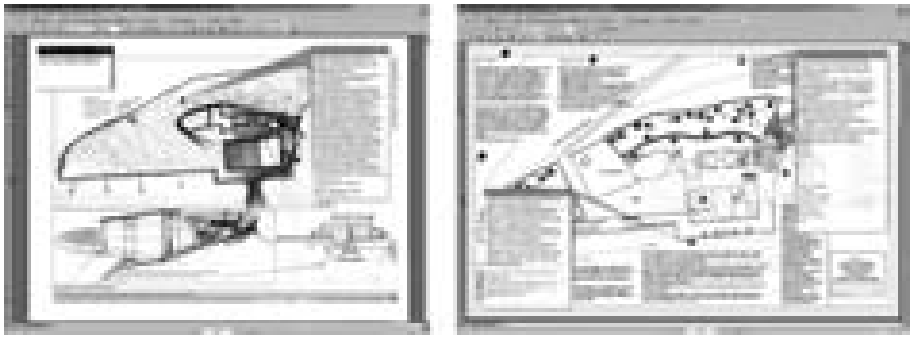


Figure 1
Examples of student's design task with teacher's annotation and correction as exchanged in the "virtual atelier".

The tutorial system: the T-Labs tool

T-Labs is a multimedia asynchronous tool designed to the revision of student's design tasks during architectural design, planning and construction courses. T-labs is structured as a virtual class where students, teachers and tutors, with different rights, share graphic files. This files, that are the students design tasks, are corrected and annotated by the teacher and can be consulted by all the course students.

The main characteristic of this didactic tool, and the basic idea of the whole system is the shift of the atelier activity from the real class in the real world to the *virtual class* in the virtual computer space.

The annotated paper, that is the most important teacher student communication mean, in the T-labs system has been transferred from the paper space to the digital computer space.

The design tasks of the students, theirs drawings, compositions and all sorts of illustrated works, have been converted in *electronic papers* (the corresponding of the real and material paper) in which students can assembly sketches, text, images, photos, cad design, renders and digital elaborations.

In the same way, the activity of the teacher has been transferred from the paper space to the digital space, in fact he corrects the student's design tasks directly on the electronic paper in the virtual space where he can add to the student's design tasks annotations, sketches, images, like writing and sketching on a classical drawing paper.

In our experience we chose to use the pdf as only file format in order to have a standardized database and to allow students to use the design and composition technique they want to perform their design tasks (they have only to convert at the end of the work their composition in Acrobat format).

The student exercises and the revised exercises are stored and exchanged in the virtual class via web (Fig. 2). In this virtual environment all students of the specific course are represented, and in each student box colored icons symbolise the students' design tasks; the different colors indicate if the specific exercise has been revised, or it needs to be revised, or if this exercise is didactically important for all the students and suggests that they should have a look at it.

From the virtual class page, the student can get into his personal page (Fig. 3) and into the single exercise page (Fig. 4). In these sections the student or the teacher may upload or download the files, can check the story of the exercises, and the teacher can check the student's progress. The student find in these pages the files revised by the teacher or by the tutors and the story of a single file recorded in the system (Fig. 5).

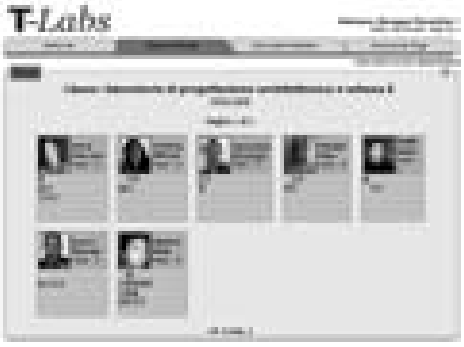


Figure 2
Examples of "virtual class page" in the T-Labs system.

Figures 3, 4
Examples of "student personal page" and "exercise page" in the T-Labs system.

Figure 5
The connection between "virtual class page", "student personal page" and "exercise page" in the T-Labs system.

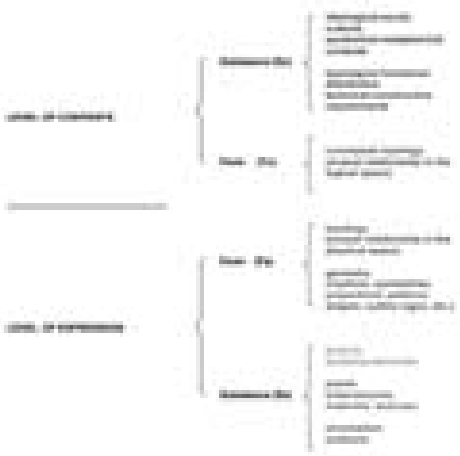
Recording the Activity of the Virtual Atelier

Architectural knowledge decomposition model

During these years of work and teaching, the system has stored a great quantity of students' works files. An enormous quantity of data that presents hints, indications, and suggestions related to the questions pertaining to the project. This material, the recording of the activity of a community of designer-students and a designer-teacher expert, strongly outlined in the pedagogic point-of-view, is presented as very destructured, at first impression, confusing and difficult to consult with. We asked ourselves if and with what methods this wealth of knowledge - in the traditional didactic activity, destined to be erased after use - could be reused and exploited in different contexts; for example, as a new offer within a course.

However, the very nature of the education acquired through studio-practice is nonlinear and this difficult to organize, and carries the risk of reducing it into a list of abstract rules for the project-design or into a manual.

For such reasons, we developed a system that provides the possibility to navigate in a personal manner through the internal contents; a system, who links the exercise to one or more keywords the instructor assigns to the student work.



This indexation motor refers to the decomposition model on a semiotic basis that recaptures the lucid and always valid intuitions of Hjelmslev, revised by Greimas and, in the field of arts and architecture, reworked by F. Thurlemann and A. Levy and our group in Venice since 1980.

Figure 6
Decomposition model for indexation. The colors signal the different categories of concept (orange), typologies (yellow), spatial topologies and other formal structures (blue), and perceptive feauter (red).

Conceptual categories of the project generative process

A design course represents, as it has been said, an effort of synthesis in which different abilities and understandings merge together.

The aim that brought to the integration of an indexing system into the virtual atelier, was to understand if and how it is possible to render explicit the tacit form of understanding (which is the know how transmitted at the drawing table in a collaborative interaction between the student and teacher and which is based on the comparison of experiences and imitation) and make the contents and flow of tacit

knowledge useable even to users who are strangers to the process, and even in different locations and time.

Such occurs through concepts that refer to other concepts and which tend to guide and produce the associative process that the student, measuring himself/herself on a projected exercise in the special and stimulating environment of the virtual classroom, puts into action during the brainstorming phase of ideas and solutions to the proposed theme.

In our experience the concepts refer to:

- meaning of the project: significance and profound sense of the project (e.g.: lightness, purity, vivacity, complexity, ambiguity) and socio-functional aspects (e.g.: public, private, representative; hall, living room, court).
- architectonic and constructive typologies: building typologies (e.g.: tower, bifamiliar house, gothic lot), typologies of building parts (e.g.: stairs, bow-window), typologies of constructive elements (bricks, steel; column, wall)
- perceptible qualities: psycho-perceptive proprieties and textural attributes of materials (e.g.: light, transparent, polychrome, smooth).
- syntactic structures: geometries, forms, shapes (e.g.: rectangular, golden section, etc.)
- design actions: operations in the composition and manipulation of the project (e.g.: deformation overlap, include, intersect, divide).
- theoretical concepts: operative categories and consolidated theories in architecture and urban planning (e.g.: land-art, metropolitan area, etc.)
- architectonic, historical and geographical references (e.g.: roman architecture, 1790, S. Geminiano, Chandigard)
- projects tools and design techniques (rhythm, symmetry, proportion)
- recurring errors and didactic advices

Indexation system

In the T-labs system to each conceptual category correspond a keywords category and within a keywords category a list of keywords is recorded relating to the specific concept. Obviously the number and the name of the keywords categories as the number and the names of the single keywords can be set down by the system administrator according to the discipline and course needs.

Going back to the student's personal page, in each exercise page he can find a list of keywords, added by the teacher to his work, related to his design task (for example about the subject of the exercise, or about a typical error or a good solution present in his work). Through this indexation system, the student may find works of other students (recorded in the system memory) that are related to same keywords and consequently and likely regarding the same problems, questions or matters of his design task.

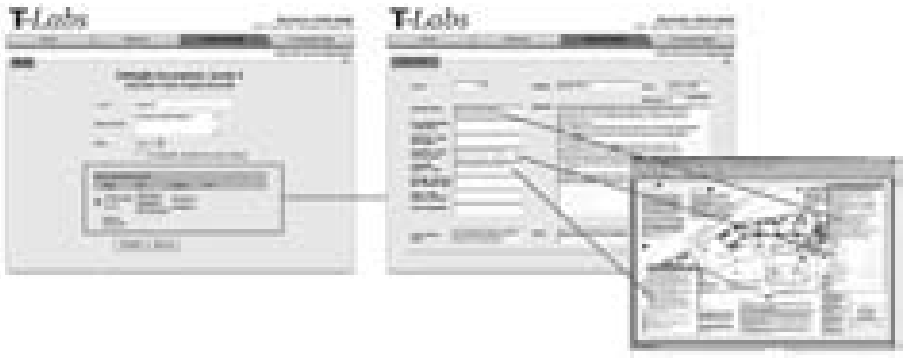


Figure 7
This indexation system is featured by T-Labs and monitors and classifies all the design tasks according to the instruction of the teacher.

Notes

1. Learning-by-doing is a concept of economic theory but it can be used also in a didactic context; in this context it refers to the capability of students to improve their knowledge, skill and training by regularly repeating similar type of exercises or by making errors or finding solutions in their design tasks. The learning process is greater if the student's work result is shared with other students and with the teacher.
2. TDraw, acronym of Telematic Drawing. Cfr. Spigai V. and others (2003), *Didattica dell'architettura in rete,* in *Atti Didamatica 2003* (by A.Andronico, G.Dettori, L.Ferlino, G.Olimpo), Genova, Italia, pp. 247-254.
3. T-Labs, acronym of Telematic Laboratories. Cfr. Spigai V. Condotta M. Stefanelli C., *Collaborative e-learning in engineering and architecture: intelligent systems for knowledge sharing in on-line design laboratories.* Pages 1082-1091 in "Joint International Conference on Computing and Decision Making in Civil and Building Engineering", Conference Proceedings, Editors: H. Rivard, E. Miresco, H. Melhem; June 14-16, 2006 – Montreal, Canada. ISBN 2-921145-58-8 ©2006.

   T-Labs software has been developed in 2005/2006 in collaboration with Archeometra s.r.l. (by G. Berti and P. Donà) within the "E-learning and web collaborative design. Implementation systems of tutorial e-learning experiences integrated with systems of corporate knowledge management", project funded by the "Italian Ministry of Education, University and Research" (PRIN National Research Program).

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