

Networking: media, representation and architecture

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ABSTRACT

In this paper we present a pedagogic work, carried out in a third year architecture course, focused on the relationship between teaching content and media. The subject-matter of the course is the concept of representation; an eminently philosophical issue which transcends the limits of a particular discipline. The media that have been used are mostly the web, along with other standard programs to process text and images, create models and animations. The core of this research work is the course 'Sistemas de Representación', which has taken place for the first time in the academic year 1999/00. The course is structured in six themes, each one standing for a system of representation: TEXT, FIGURE, OBJECT, IMAGE, SPACE and LIGHT. Within every system, a variety of topics dealing with the concept of representation are addressed in an interdisciplinary manner. A web based learning environment named NETWORKING has been created especially for the course. This environment allows students to perform a variety of collaborative works: drawing visual and linguistic relationships, developing further the works of other students, and participating in collective processes of form generation and space perception.

1 MEDIA AND CONTENT: THE QUEST FOR INTERDISCIPLINARITY

In his premonitory book *Understanding Media*, from 1964, Marshall McLuhan described the post-industrial era in these terms: "This is the Age of Anxiety for the reason of the electric implosion that compels commitment and participation, quite regardless of any 'point of view'. The partial and specialized character of the viewpoint, however noble, will not serve at all in the electric age" (McLuhan 1997). And he concluded: "The mark of our time is its revulsion against imposed patterns. We are suddenly eager to have things and people declare their beings totally" (McLuhan 1997). The electric society that McLuhan was referring to is the information age of our time, and the medium that epitomizes participation and totality is the Internet.

As a matter of fact, it can be observed that during the last decades the quest for 'total knowledge' has been growing in parallel to the development of the computer media. While in earlier times each discipline was striving to delimit its own territory, today the goal is to transcend those limits, searching for connections among different

fields of knowledge. Multidisciplinarity and interdisciplinarity are the hallmarks of contemporary culture, whereas Internet is the technological framework that supports and symbolizes this cultural shift.ⁱ

The education system has also begun to adapt itself to the new cultural objectives. In different places around the world, new academic structures are being created to promote exchange between disciplines.ⁱⁱ The integration of computer media into education can effectively contribute to the achievement of this goal. In computer assisted education, the characteristics of the medium tend to be transferred to the content. A subject-matter taught on the web, for example, will be imbued with some of the intrinsic characteristics of this medium, like interdisciplinarity. In this sense, the use of the web in education also contributes to the questioning of the fixed compartments of knowledge and the permanence of established subjects.ⁱⁱⁱ

2 REPRESENTATION AS SUBJECT-MATTER

Representation is an eminently philosophical notion, which transcends the boundaries in which knowledge has been divided. The specific meaning of the concept varies in each discipline. In art, a representation is any art form which fulfills an aesthetic purpose. In geometry, a representation systems refers to a specific technique used to depict three-dimensional bodies in two dimensions (projective systems, like eye perspective, axonometric). In architecture, representation encompasses personal expression through graphic (e.g. sketches) or plastic (e.g. physical models) means, as well as graphic languages and conventions to represent a building at different scales, using plans, sections and elevations. In linguistics, a language is considered a symbol system that represents the real world. In psychology, a representation is mostly considered as a subjective mental image. Cognitive sciences are concerned with objective representations, like the conceptual structures involved in problem-solving. This multiplicity of meanings, with which the term representation has been endowed, can only give us a clue of the transcendence of the concept.

The increasing degree of self-consciousness of our cognitive mechanisms, developed over the last three centuries, is manifested in the prevailing epistemological meanings with which the concept of representation has been endowed. Since Kant's philosophy, the notion of representation has acquired a status of reality. From a conceptualist approach, a representation, rather than being the mirrored image of an external world, is seen as an abstract system that mediates between the subject and the object. Furthermore, as Hamelin suggested, representation can be taken as the only reality; a reality that transcends the opposition subject/object.^{iv}

At this point, representation might as well be considered a subject-matter in its own right. Representation, by cutting across disciplinary boundaries, becomes the fundamental subject-matter of interdisciplinary knowledge. An example of this approach is in the work of Nelson Goodman, *Languages of Art*, where representation is understood as a symbol system which is applicable both to the arts and to the sciences. According to Goodman, "The difference between art and science (is a) difference in domination of certain specific characteristics of symbols" (Goodman

1976, p.264). Such a transcendental view of representation would lead, according to Goodman, to fundamental changes in education: "Once the arts and sciences are seen to involve working with -inventing, applying, reading, transforming, manipulating-symbol systems that agree and differ in certain specific ways, we can perhaps undertake pointed psychological investigation of how the pertinent skills inhibit or enhance one another; and the outcome might well call for changes in educational technology" (Goodman 1976, p.265).

3 SDR: 'SISTEMAS DE REPRESENTACION'

Representation is the subject-matter of the course 'SDR:Sistemas de Representación'. Around the concept of representation, we seek to create a new conceptual framework which embraces a variety of disciplines: *gestaltung*, graphic design, communication, aesthetics, philosophy and computing.

We believe that, in the culture of our times, a course on representation for architecture students should not be restricted to teaching techniques for graphic expression nor projection systems. Rather, it needs to embrace the whole range of issues that are involved in the act of representing, being epistemological, aesthetic, or technological.

Computer media is an integral part of this course, both from a conceptual and from a practical point of view. From a theoretical point of view, the course aims at building up the 'total knowledge' brought about by computer media -particularly the web. From a practical standpoint, the goal is that students learn to think, to express and to communicate their ideas with computer media.^v

3.1 Course content

The course is structured in six themes, each one standing for a representation system: TEXT, SHAPE, OBJECT, IMAGE, SPACE and LIGHT.^{vi} For each theme there are a series of lectures, an individual exercise and a collaborative one carried out on the web learning environment NETWORKING, especially created for this course.

Table 1 summarizes the topics and the related exercises. The theoretical content is available on the web site of the course (<http://www.salleURL.edu/sdr>). Ideas are explained in a concise manner, using multimedia techniques (Figure 1). On-line tutorials introduce students to the basics of the computer programs used to carry out the exercises.

4 NETWORKING: a WEB environment to support collaborative learning.

To fulfill the pedagogic goals set up for this course, we have found it necessary to implement a web based learning environment named NETWORKING^{vii}. Its purpose is to help students think associatively and be creative in collaboration with other students. Each one of the six themes has its own NETWORKING environment.

Table 1: **Course Content**

THEME	TOPICS	INDIVIDUAL WORK	INSTRUMENTS	COLLECTIVE WORK
TEXT	Text and hypertext. Graphic design and communication. Interface design. Avant-garde manifestoes.	Analysis of the content of the text and visual re-interpretation of the manifesto with web pages.	Word processor, HTML, Manual techniques (labels and threads).	Vocabulary derived from analyzed texts. Linking concepts across texts, explaining differences and similarities.
SHAPE	Figuration and abstraction. The language of painting. Rules of composition. Gestalt and form.	Explaining composition rules of an abstract work through an animation. Apply rules to new composition. Create a series of variations.	Photoshop, Freehand, Anim. GIF. Manual techniques (sketching, cardboard cutting).	Adding a new variation to a series created by another student. Associating keywords to the works created by others.
OBJECT	Formal languages in modern art: line, plane and solid. Rules of transformation. Generative systems.	Design of an abstract object based on the language of the line. Design of an object composed of planes, and explanation of the formation process with an animation.	AutoCAD, 3dStudio Physical models.	Adding views and keywords to the object designed by another student. Making groups with objects. Collaborative creation of a solid object.
IMAGE	Idea and image. Photography and modern art. Photomontage. Cognitive dimension of the image.	Photographing the city, collecting images from all sources. Photomontage.	Photoshop Photo Video.	Create associations between images. Combine them in a photomontage.
SPACE	Concepts of space. Conceived space, perceived space. Cognitive maps. Space and motion. Space narratives.	Design of a spatial unit and description of its attributes as object and as perceived space. Associating events and images.	3dStudio VRML	Collective process of space creation, assembling spatial units.
LIGHT	Concepts of light. Light representation in painting. Space and light in architecture.	Create an atmosphere in a spatial unit by means of light.	Lightscape	Associate emotions with different light situations.



Figure 1: Web site of the course ‘Sistemas de Representación’, where the principles of the formal languages in modern art are explained.



Figure 2. Networking: figure



Figure 3. Networking: object



Figure 4. Networking: image

With NETWORKING, students upload and download their individual works, associate keywords and views with the works of other students, establish relationships between different exercises, and participate in processes of form generation and space perception. At the moment of writing this paper, we have implemented and applied three of these environments to our teaching: FIGURE, OBJECT and IMAGE. The interface and modes of operating are common for every environment, regardless of the theme. However, each one has its own idiosyncrasies, depending on the specific exercise (Figures 2-4).

This environment contains the two- dimensional compositions created by each student, and a series of variations of it. The relationship between the composition type and the variation is described with a short comment. The vocabulary of variation names proposed by the whole class appears on the right side.

This environment is, in turn, divided into three parts, each one corresponding to a formal language: line, plane and solid. In LINE/PLANE, each object created by a student is represented in the database by means of an icon, a name, a concise description, a 3d model, a series of views and animations, and an associated list of keywords. The SOLID object is developed collectively by the whole class using an interactive environment created for this purpose (see below).

This environment encompasses three databases: 1. photographs of the city of Barcelona taken by students on selected topics (public spaces, monuments, infrastructures...) 2. photographs from any other source, about any topic 3. photomontages composed from the previous images. A special environment allows groups of relationships with images of type 1 and 2 to be made.

4.1 Networking: object

To explain how NETWORKING operates and how it is integrated in the dynamic of the course, we will restrict the following discussion to the OBJECT environment.

4.1.1 Object:[LINE, PLANE]

Typically, an exercise is divided into two distinct parts: first, individual work, then collaborative work. In the theme OBJECT:[LINE, PLANE], each student is asked to create a 3d object based on the language of the line with a 3d computer modeler. The design takes 2 to 3 weeks, and during this time tutors follow closely with the student the development of the design. The individual work ends with a presentation of the work to the class. This way, we can be sure that each student has understood the critical issues before engaging in a collective process of work. Also, in this way we can guarantee a certain design quality of the individual works, before they are submitted to the collective environment.

Each student submits his/her work using special procedures and forms which are part of the NETWORKING environment.

Each work shows up on the web as an icon surrounded by all its relevant attributes: the object's name, the author's name, a short description and associated keywords. This information, stored in a relational database, can later be displayed by theme, author, object, or concept.

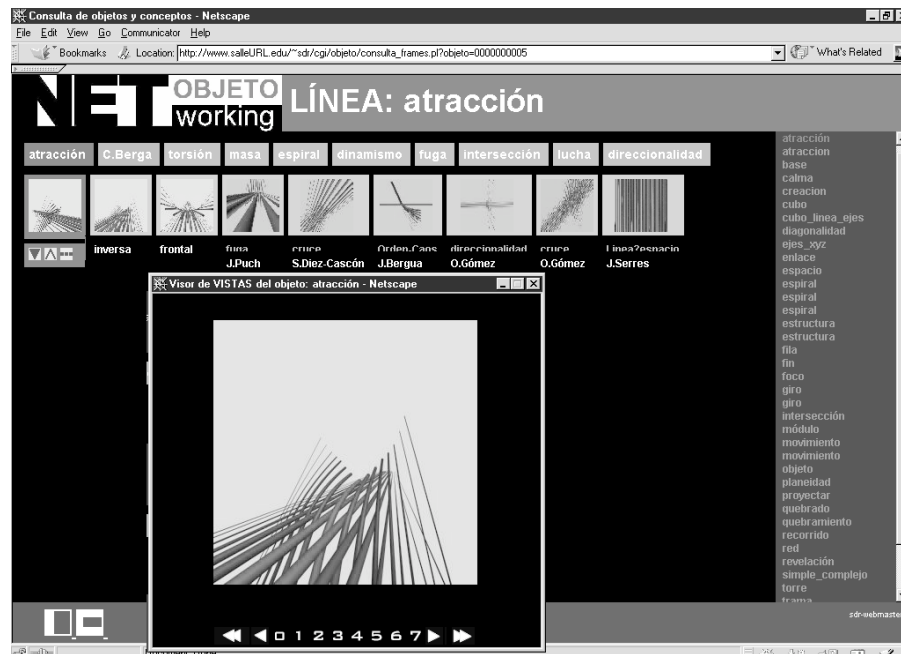


Figure 5: NETWORKING: OBJECT[LINE]. View by OBJECT NAME. This view focuses on a single work. It shows the views associated to the object, which can be static or dynamic, made by the author of the work or added by some other student (in this case the name of the corresponding author appears directly under the view name). A special viewer allows one to browse quickly through the views. To keep navigating within the category OBJECT, the name of another work can be selected from the list on the right.

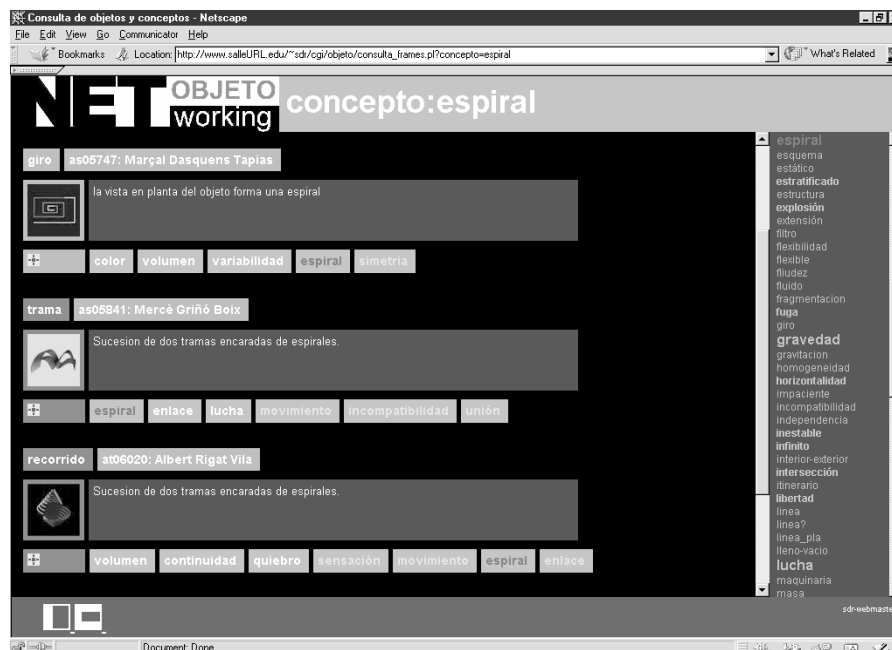


Figure 6: NETWORKING: OBJECT[LINE]. View by CONCEPT. This view shows all the objects which have associated the concept 'espiral'. All other available concepts are alphabetically sorted in the list on the right. The font size gives an indication of the number of objects that are attached to a particular concept: the heavier the font, the larger the number of associated objects. A color coding is used to distinguish between concepts added by the author and concepts added by someone else. To keep navigating within this mode, one can choose another concept from the right-hand list or from the tags that surround each object.

All querying categories are interwoven through the navigation. For example, to focus on a particular work, one must click on its name. Then, the category in the header changes to OBJECT NAME, and the different views of the selected work appear in the main window. (Figure 5)

Similarly, clicking on any of the associated keywords would change the querying category to CONCEPT. Then, the selected keyword would be displayed in the header and all of the works related to that concept would appear in the main window (Figure 6).

Once the individual works have been submitted, different kinds of collective work take place, namely: 1. adding views to the object, 2. adding keywords and 3. creating groups of works. Each one of these works is performed with user-friendly environments, especially devised to make the task easy and intuitive.



Figure 7. NETWORKING: OBJECT. Interface to add views to an existing object. If a view has been added by a third student, her name appears at the bottom. The arrows located at the foot of the object icon are used to upload and download files. Under the header 'objetos relacionados' (related objects) appear all other objects related to it.

1. Adding views

Students are asked to pick an object of their choice in order to create new views of it. These views must reflect how they perceive that object, which might coincide or not with the original intention of the author. To give a clue as to the significance of the view they create, a name is submitted along with the image. Through this exercise students learn to search for meaningful shapes in the forms created by others (Figure 8).

2. Adding keywords

Each individual work is submitted along with a number of concepts which are defined by the student. This vocabulary is stored in a database and can later be used by other students to add other concepts to the works of others. With this exercise, students develop their linguistic skills as well their capacity to associate shapes and words. (Figure 8)



Figure 8: NETWORKING: OBJECT. Interface to assign a keyword of the existing vocabulary to an object. The list of available concepts appears in the left column. The main window shows the various definitions of each concept, as formulated by students. If none of the existing definitions fits the object, it is possible to add a new one.

3. Making groups

Students are asked to group objects according to the common characteristics they perceived in them. This way, they create a new network of associations, superimposed on the existing net of concept relations. With this exercise, students develop their ability to find common features in objects, and to describe them with precise words (Figure 9).



Figure 9: NETWORKING: OBJECT. Interface to group objects that share some attributes, according to the student's perception. To create a group it is enough to drag the icons to the lower frame. A description of the common attributes is introduced afterwards.

4.1.2 OBJECT:[SOLID]

The environment NETWORKING: OBJECT: [SOLID] has been devised to carry out a collective process of form generation. The forty-student class was divided into four groups of ten. Four different objects started to be developed at once, each one represented by a color. Each group of students was given 2-3 days to contribute to the process of the development of the object. After finishing one stage, a group would move to another object. The whole process would end in the fourth stage. This way, at the end of the process each student would have participated in the development of the four objects (Figure 10).

Before starting with the development process, the class created a set of transformation rules that would later be applied to the transformation process. (Figure 11). Then each student would choose one or more rules of the vocabulary to be applied in the first stage of development. For the second stage, students were asked to choose the object that was most appealing to them, to describe its gestalt with a written text, and to apply another transformation that was coherent with the perceived form.

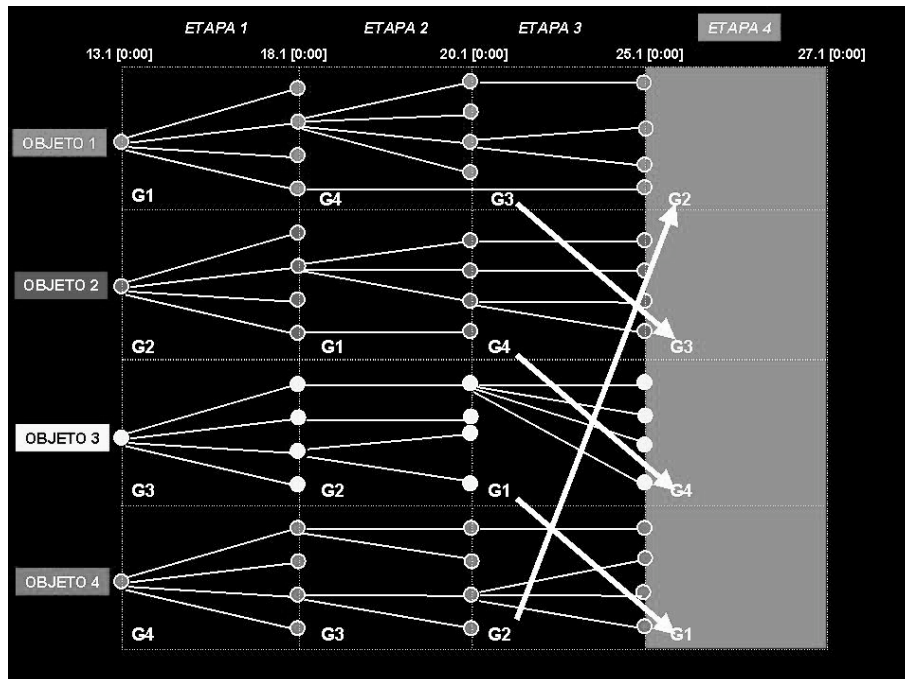


Figure 10: NETWORKING OBJECT: [SOLID]. Diagram of the process of collective development of a solid object in four stages.



Figure 11: NETWORKING OBJECT: SOLID. First stage of the development process of OBJECT#3. Before starting the process, a set of transformation rules has been collectively created by all students. Then, students choose one or more rules and apply them to the original cube.

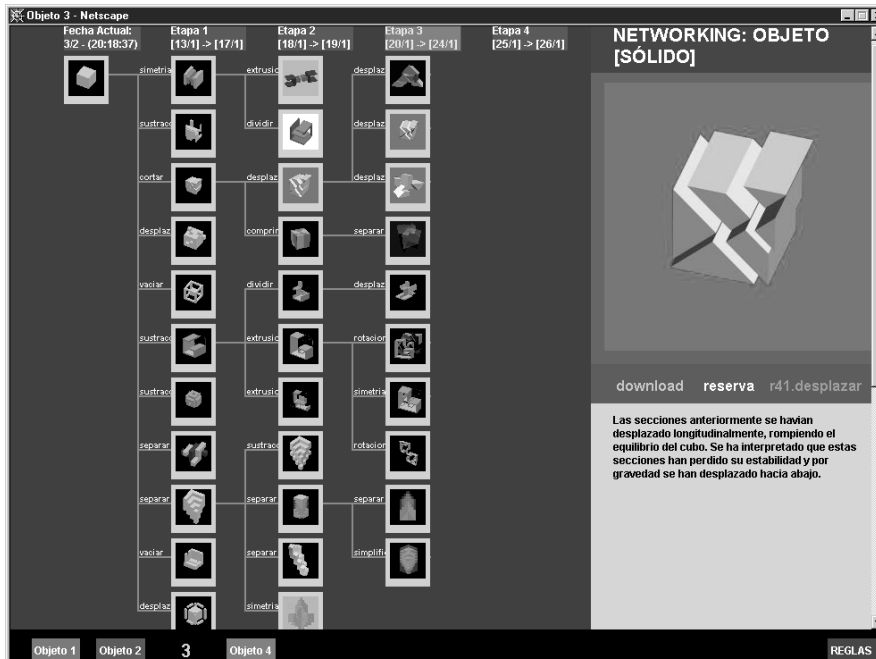


Figure 12: NETWORKING OBJECT: SOLID. Third stage of development of OBJECT#3. Objects 1, 2, and 4 were being developed in parallel. To access the other three objects, one must select the corresponding button in the lower frame.

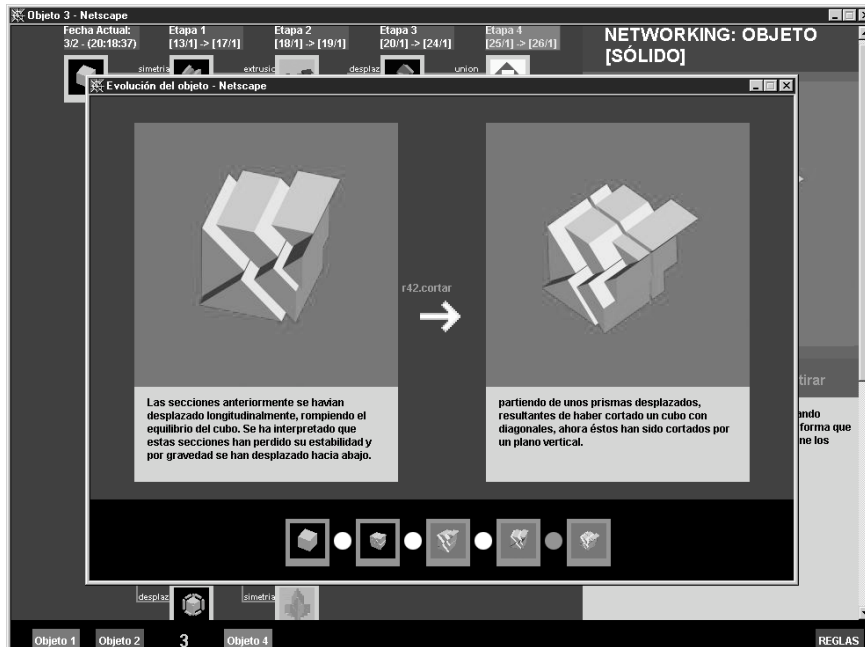


Figure 13: NETWORKING OBJECT: SOLID. Retrospective view of the object's development. At every stage in the process, one can trace back the development of the object in the process viewer. This shows in the lower part the path of evolution of the object. Placing the mouse over the icon one can see the enlarged image of the object and its precedent. This way, it is possible to check the consistency of the development process, both from the point of view of the form and the narrative.

The next two stages proceeded in a similar fashion, giving rise to a tree structure (Figure 13). However, as the process went on, new issues were coming into play that would influence the development of the forms. Whereas at the beginning of the process the set of rules was determining the form development, later on the narratives related to the object and its aesthetic qualities (color, proportion, gestalt) became the most influential factors.^{viii}

This sort of collaborative work done on the web has contributed greatly to the group dynamics. It makes students become more interested in the work of their peers and thus promotes an exchange of opinions among the class. For this to occur, however, the web environment has to be understood as a supporting medium which brings another level of interaction (and abstraction) to the traditional education, rather than as substitute for it.

5 CONCLUSIONS

Computer media not only transforms how we are teaching but, most importantly, what we are teaching. Medium and content cannot stand apart from each other; rather, they become inseparable. Therefore, integrating computer media into education goes beyond the simple application of it. The real challenge for educators is to re-think the inherited subject-matters in light of the new technologies.

Students taking the course we have described have the opportunity to engage in interdisciplinary thinking, in a theoretical and a practical way. Even though the course is currently limited to architecture students, we expect to open it to students from other fields (graphic design, film making, advertisement, multimedia) in the near future. This way, the interdisciplinarity would be achieved in three different manners: through the content of the course, through computer media and through the participants.

Often, we see computer tools being developed with the sole purpose of pushing to the limit what is technologically possible in a given time. The results might appear exciting from the point of view of technology, but they can be meaningless from the point of view of education. In the near future, we expect to continue developing NETWORKING, completing the six themes and incorporating individual environments that facilitate the exchange of ideas among students. In doing so, however, we will strive to keep the balance between what is technologically feasible and what is pedagogically meaningful.

6 ACKNOWLEDGMENTS

Programming the NETWORKING environment has been the work of Francesc Duran and Jorge Jiménez, from the ARC group (Architecture, Representation, Computing) of the E.T.S. d'Arquitectura La Salle. Thanks to their excellent work, we have been able to develop and implement this learning environment in the short span of four months. I would also like to thank Eduardo Hernández for his support in teaching this

course, particularly for his remarkable work guiding the students during the development of the exercises.

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URLs:

<http://www.salleURL.edu/sdr>

<http://www.salleURL.edu/sdr/networking/figura>

<http://www.salleURL.edu/sdr/networking/objeto>

ⁱ In spite of the widespread acceptance that the idea of interdisciplinarity seems to enjoy nowadays, its meaning and value are nevertheless being criticized. Julia Kristeva sees these dangers in it: "Some people think their specialisation is interdisciplinarity itself, which is tantamount to saying that they have a limited amount of knowledge of various domains, and only fragmentary competences!. This gives interdisciplinarity a very caricatural image, and altogether reduces its scope as a project." (Coles and Defert 1998, p.6)

ⁱⁱ For instance, the Université Paris VII has founded L'Institute du Vivant to approach the human being from a variety of disciplines. Similarly, the ETH Zurich has established the Collegium Helveticum as a new forum to promote interdisciplinarity.

ⁱⁱⁱ These words of MacLuhan referring to the changes in education are equally applicable to our current situation: "In education the conventional division of the curriculum into subjects is already as outdated as the medieval trivium and quadrivium after the Renaissance. Any subject taken in depth at once relates to other subjects. Arithmetic in grade three or nine, when taught in terms of number theory, symbolic logic, and cultural history, ceases to be mere practice in problems. Continued in their present patterns of fragmented unrelation, our school curricula will insure a citizenry unable to understand the cybernated world in which they live". (McLuhan 1964, p.347)

^{iv} La représentation, contrairement à la signification étymologique du mot, car il faut bien emprunter les mots au sens commun, ne représente pas, ne reflète pas un objet et un sujet qui existeraient sans elle: elle este l'objet et le sujet, elle est la réalité même. La représentation est l'être et l'être est la representation" (Hamelin 1952, p. 279)

^v We do not exclude for that matter the use of so-called traditional techniques, like sketching and physical models, or other media like photography or video. As a matter of fact, the translation of an idea across different representation systems is one of the issues addressed in the course. However, elaborating on the issue is beyond the scope of this paper.

^{vi} The direct predecessor of this course was the course STRUCTURES, taught within the postgraduate program of the Professur für Architektur und CAAD, ETH Zurich, in the years 1996-99. (Madrado 1996). On-line version in <http://caad.arch.ethz.ch/teaching/nds/ws98>.

^{vii} The web environment has been implemented using CGI scripts written in Perl5, linked to a MySQL relational database.

^{viii} Since 1996, web environments to carry out collaborative work have been applied to teaching in the Professur für Architektur und CAAD, ETH Zürich (Hirschberg and Wenz 1997). The application we have developed differs from previous experiences carried out in Zurich in a number of ways: by defining a number of rules prior to the beginning of the process, by limiting the scope of the formal development to 3d objects, by developing four formal processes in parallel so that all students participate in each process, by asking the student to be explicit about the gestalt perceived in the object and the transformation that this is undergoing. Moreover, we see this sort of web based collaborative process as an opportunity to reason on the formal process, and not so much as an autonomous system of form generation. Nor is this environment meant to be used for distance learning, but quite the contrary: the most fruitful outcome of it has been the debates held with students in the class.