NETWORKING:SPACE, multiple space representations in a web-based learning environment.

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Abstract: ***Space can be conceived as extension, as void, as motion, or as relationship between elements. Each of these space conceptions has a representation on the computer: the cartesian space in a CAD program, the voids created with solid modeling, the walkthrough of an animation, or the network of links on the web. There is yet another space concept that results from the interaction between users in a computer network: this is cyberspace, a space of interaction via interfaces. SDR: NETWORKING: SPACE is a web-based environment for collaborative learning that integrates all of these space conceptions in a unified conceptual framework.***

1. SDR and SDR:NETWORKING

SDR: NETWORKING: SPACE is part of a comprehensive web-based learning system, used in the course SDR, Sistemas de Representación[1]. The course is structured in six themes, whose common denominator is the concept of representation: TEXT, SHAPE, IMAGE, OBJECT, SPACE and LIGHT. Each theme has a corresponding SDR:NETWORKING environment for the students to carry out the exercises.

In accordance with the spirit of the net, the course SDR is multidisciplinary and participative. Around the concept of representation, we seek to create a new conceptual framework that embraces a variety of disciplines: gestaltung, graphic design, communication, aesthetics, philosophy and computing. The exercises are done individually and collaboratively, using the SDR:NETWORKING environments. With these environments students can analyze texts working in collaboration, comment on the works of their peers, continue the work initiated by another student, establish relationships between exercises, and participate in collaborative processes of form generation and space perception.

1.1. Concepts of space

In the lectures about the theme SPACE, different conceptions of space are introduced to the students: philosophical (space as matter, space as a priori category, space as existence), mathematical (relative and absolute, euclidean and non-euclidian), psychological (space and body, kinaesthesia, haptic sense), artistic (vision and space, perspective, cubism), architectural (space as inner void, as outer space, motion in space) and social (urban space,

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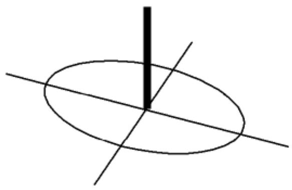
[1]Madrazo, L. SDR: Sistemas de Representación. Barcelona: Escola Tècnica i Superior d'Arquitectura La Salle, 2000. (www.salleurl.edu/sdr)

cyberspace). An initial consequence of this multidisciplinary approach is the realization that each discipline attempts to construct a different notion of space that better fits its premises and goals. However, any attempt to restrain such a fundamental concept as space within the limits of a particular discipline is bound to become meaningless. Space is a fundamental category on which human knowledge is based and, as such, it transcends any disciplinary boundary.[2]

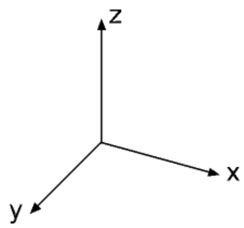
A second realization is the contingent nature of the concepts of space: each culture and each generation develops their own notion of space. In this regard, the notion of cyberspace would be the paradigm of our contemporary conception of space: a space which does not stem directly from our world of experience, but rather, one that is the result of the intertwining between the world of experience and the virtual world born out of computer networks.

In order to facilitate the link between the theoretical background provided in the classes and the practical exercises, we distinguish between these two basic space conceptions:[3]

1. space as experience, that is, the place where all the experience of the subject takes place. This is the space of the being; the space of our existence, as Heidegger defined it ("Das Dasein ist raümlich"). Its reference axis coincides with the observer: what is near to him is more important than what is far. It is an anisotropic space: its properties might not be the same at all of its points.



2. space as extension, that is, the space in itself, which exists independently from the subject. This is the cartesian space, defined by the three orthogonal axes, where the position of each point is defined with three coordinates. It is a space seen from outside; an isotropic space where each point has the same properties, regardless of its position.



[2] For example, in the theory elaborated by Kevin Lynch in *The Image of the City*, there are philosophical and psychological connotations imbued in what, at the outset, might appear to be a purely urban notion of space.

[3] Merleau-Ponty, in his *Phénoménologie de la perception*, distinguished between a physical space where things are ordered in relationship to our bodies (up and down, left and right, far and near) and a geometric space, homogeneous and isotropic. The first concept of space would result from our spontaneous interaction with objects in our physical environment, while the second can only be the result of a conscious reflection. Abraham Moles, in his *Psychologie de l'espace*, also differentiates between a space which is perceived by 'me, here, now' and the space which is perceived from outside, as an 'extension'. He thinks that "Les deux systèmes que nous venons de décrire sont à la fois *essentiels* et *contradictoires*; irréductibles l'un à l'autre, ils se partagent nos pensées d'espace et nous passons de l'un à l'autre dans notre vocabulaires comme dans nos comportements". Moles, Abraham; Rohmer, Élisabeth. Psychologie de l'espace, Tournai: Casterman, 1972, p.10.

2. Methodology of the exercises

The exercises are divided into two parts, dealing with: 1. bodily experience of space 2. digital representation of space. With the first part of the exercise, we want to make students aware of the space that cannot be dissociated from our existence in it. This notion of space becomes the necessary reference of the subsequent space representations that they will create in the digital realm.

It is our contention that what we create on the computer are abstractions of our space experiences. A walkthrough in a computer model, for example, would be an abstraction of the motion of our body in space. Cyberspace might be different though, since it creates a sense of space with no counterpart in the 'known' world (i.e. the world of our bodily experience). Because of this, cyberspace enhances our world of experience, adding a new dimension to it.[4]

2.1. Part1: The bodily experience of space

First, students are asked to create a cognitive map of a space they have personally experienced. This cognitive map is a representation of a space through a personal graphic language. The map might encompass multiple perceptual dimensions: space relations, motion paths, events, and memories (Figures 1, 2). It is a way to represent space that is different to the established architectural graphic conventions, like plans and sections, which emphasize formal and geometric characteristics at the expense of experiential ones.[5]

Figure 1. Representation of the space of the Jewish Museum, Berlin. Student: Marçal Dasquens Tapias.

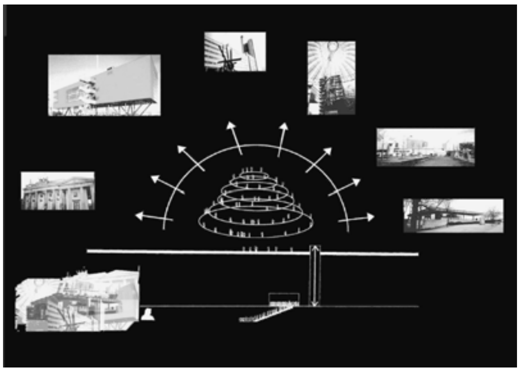


Figure 2. Representation of the space of the Reichstag, Berlin. Student: Esther Diaz Salas.

[4] J.Suler thinks that "On an even deeper psychological level, users often describe how their computer is an extension of their mind and personality - a 'space' that reflects their tastes, attitudes, and interests. In psychoanalytic terms, computers and cyberspace may become a type of 'transitional space' that is an extension of the individual's intrapsychic world. It may be experienced as an intermediate zone between self and other that is part self and part other." And concludes: "When one experiences cyberspace as this extension of one's mind - as a transitional space between self and other." J. Suler, The psychology of avatars and graphical space. The Psychology of Cyberspace, 1999.

[5] Moore and Allen have referred to the limitations of architectural drawings to represent space in those terms: "For one thing, we do not draw space, but rather plans and sections in which the space lurks. So there is a constant temptation to focus on objects rather than on the architectural space they breathe into existence. Drawing-board victories (like getting everything lined up) replace and negate the real pleasures discoverable in space". Moore, Charles; Allen, Gerald. Dimensions: space, shape and scale in architecture. New York: Architectural Record, 1976, 7-8.

2.2. Part 2: Digital space

This part of the exercise is carried out using a combination of standard computer programs (fundamentally 3dStudioMax and Autocad) and the web-based learning environment SDR:NETWORKING:SPACE. The sequence of the work is the following:

a) creation of a spatial unit.
b) creating relationships between the units created by different students.
c) defining spatial sequences that connect spaces previously related.

The exercises are done individually and in collaboration. First, students submit to the system a spatial unit they have designed. Then, using two interfaces named MODELER and METAVIEWER, they establish relationships and construct spatial sequences with the spatial units created by the whole class (Figure 3).

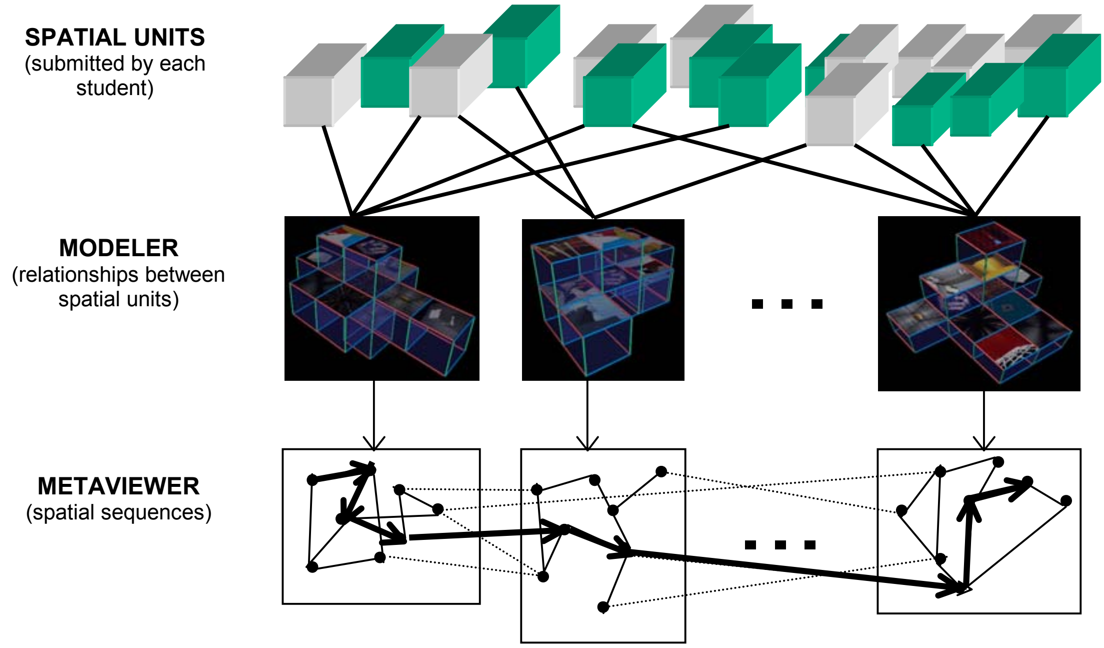


Figure 3. Structure of the exercise sequence and the environments to carry it out.

A. SPATIAL UNITS

The task is to design a spatial cell within a cubic boundary. The cell has to be described at three different levels: 1. *geometric*, which refers to the objective qualities of the object-space (form, color, components) 2. *perceptual*, that is, a description of the effects (impressions, emotions) that the space provokes in the beholder 3. *narrative*, associating a text (written by the student, or taken from literary sources) and an image to the space.[6]

[6] With this threefold description of the space, we want to emphasize the close links that exist between our space conceptions and language. As Antoine de Saint-Exupéry wrote: "What is distance? I know that nothing which trully concerns man is calculable, weighable, measurable. True distance is not the concern of the eye; it is granted only to the spirit. Its value is the value of language, for it is language which binds things together." A. Saint-Exupéry, Flight to Arras. New York: Reynal and Hitchcock, 1942.

The goal of the exercise is to make a student aware of the interrelationships between different space dimensions in the process of designing a space.[7] Students can adopt different strategies to carry out the exercise. Some might focus on a spatial scheme that causes a certain motion pattern, like a court and the circular motion that it provokes. Others might rely on circulation elements (stairs, ramps) to keep the motion of the beholder through space controlled. And yet others might be concerned with the spiritual atmosphere of the space. Whatever the strategy that is adopted, a relation between the three dimensions of space must be present in the design.

This work is done individually and then submitted to the system's database using the web-based environment. Each student sends a VRML model (.wrl); geometric data (.dxf, .max); a recorded animation (.avi); and an associated text and image. (Figure 4)

Figure 4. The spatial unit as represented in SDR:NETWORKING:SPACE. Each one of the three descriptions of the space (geometric, perceptual, narrative) is identified by its color. It is a space where the spectator loses all reference to the outside. Inside, there is no scale and no predominant orientation; a visual metaphor of being enclosed. Student: Carles Berga, SDR 99/00.

Once the spatial units have been submitted, the first collaborative task takes place: each student is asked to 'experience' a space created by another colleague. This spatial experience is represented by a motion path and a short text. The goal of the exercise is

[7] It is self-evident that when designing a space we take instinctively into consideration a multiplicity of space conceptions. However, as Boudon has pointed out, making the relationship between the different space conceptions explicit might not be an easy task: "...espace *vrai*, espace *architectural*, espace *géométrique*, espace *vécu*, espace de *représentation*. Les relations entre ces divers espaces sont loin d'être évidentes". Boudon, Philippe. Sur l'espace architectural: essai d'épistémologie de l'architecture. Paris: Dunod, 1971, 21.

to contrast the different spatial interpretations that one space gives rise to in different beholders.[8]

At the current stage of development of the system SDR:NETWORKING:SPACE, it is necessary to use 3dStudioMax to add a path to an existing VRML model. The user downloads the .max file from the system and makes an animation with 3dStudioMax. Then, through an ad-hoc automated procedure, the geometric description of the path is extracted from the .max file and added to the original .wrl model.[9]

B. SPATIAL RELATIONS

The next collaborative task is to establish relationships between the different spatial units. The relationships are set up by assembling the cells in a VRML environment called MODELER (Figure 5).

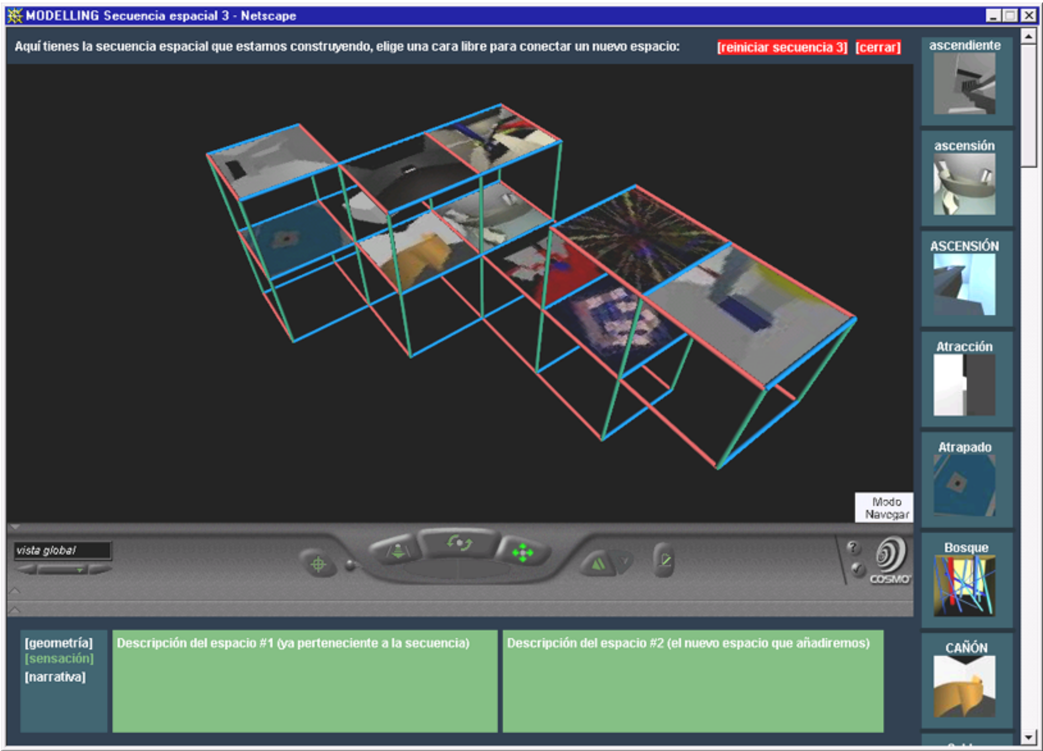


Figure 5. The MODELER environment to establish relationships between spatial units.

Each one of the three axes (red, green, blue) of the model space corresponds to one of the three dimensions of a cell, namely: geometric, perceptual, and narrative. Cells might be related to each other at each of these three levels. To establish a relationship, a cell (represented as a wireframe cube with an icon) is selected from the menu and placed in the model in the direction of the corresponding axis. The outcome is a three-dimensional structure that is the visual expression of the relationships between cells.

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[8] With VR techniques this identification of the user with the avatar is more persuasive than moving through a scene on a computer monitor.
[9] Ideally, we should have the possibility of recording a path directly on the browser. This functionality is not provided in the standard VRML viewer. Therefore, it is necessary to create an ad-hoc environment to do it. This is one of the features to add to future versions of the system.

To carry out this relational model, the class is divided into groups (typically, 4-5 groups, of 10 students). Each group begins to assemble a relational model and, after 2-3 days of work, moves onto another model. This way, all students participate in the assembly of each single model. At the end of the process, we have as many models as groups of students, each one describing a different set of spatial relationships.

C. SPATIAL SEQUENCES

Once the relationships between units have been established, it becomes possible to create spatial sequences, moving in any direction within the network of relations established in the models. The environment used to create the spatial sequences is named METAVIEWER (Figure 6).

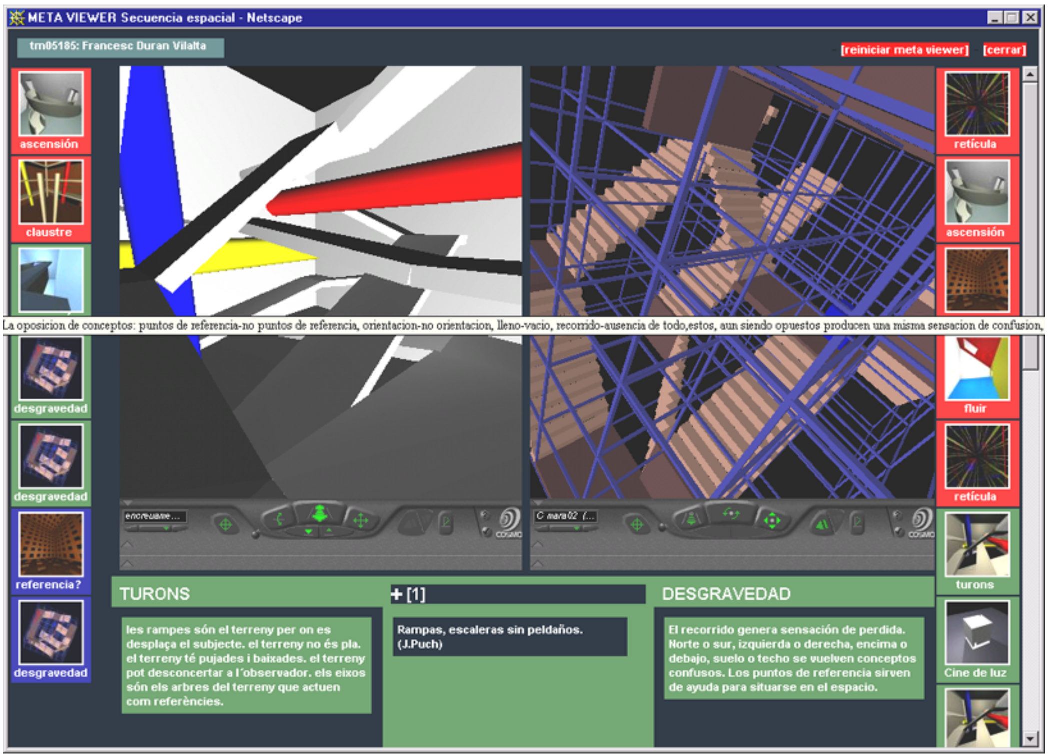

Figure 6. The METAVIEWER environment to create sequences of spatial relationships.

The interface has been designed to facilitate free navigation from one unit to another. The central area shows the VRML models of two spaces that hold some sort of relationship (geometric, perceptual, narrative). The icons of the spaces that are in turn related to each one of these two spaces are shown on the left and on the right. The color of the icon indicates the kind of relationship: cells related at the geometric level are represented in red; those related at the perceptual level in green; and in blue the ones connected at the narrative level. Selecting an icon on the left or right allows the user to move within the network of relationships. The selected space then appears on the corresponding side of the central window while the list of associated spaces changes.

Users navigating through this environment can leave their comments on the relations they observed between two selected spaces. These comments are introduced in the text box located at the bottom of the interface. This way, a new narrative is collectively created. It is the expression of a cyberspace, a space built up from relationships between items of information that are relevant to users.

The cyberspace qualities that result from the interaction between users in the SDR:NETWORKING:ENVIRONMENT must be distinguished from other cyberspaces, like network computer games and chat rooms. Users participating in a computer game, for example, are compelled to achieve certain goals. To achieve their purposes, they might have to build strategies together with other participants. The existence of goals and the synchronous interaction between users contributes to the creation of a strong sense of place in these games. This sense of being part of a cyberspace at a given moment is not so strong in our environment as it stands now. Further developments of the system should improve this cyberspace quality.

Conclusions

We have created a pedagogic framework that relates multiple space conceptions in a theoretical and practical way. The theoretical content of the course is in itself a network of space concepts from different disciplines. In their practical work, students synthesize the different space conceptions in their designs, and explore multiple space dimensions in the web-based learning environment of the course. All in all, we believe that with this pedagogic framework (theoretical content, exercises and web environment) we have been able to teach students the subject matter of space from a contemporary perspective.

Acknowledgements

The programming of the system has been the work of Francesc Duran. His graduation project as Multimedia Technical Engineer at Enginyeria La Salle was the implementation of SDR:NETWORKING:SPACE as the teaching environment for the course SDR, Sistemas de Representación. The environment has been programmed using VRML, Perl5 scripts accessing a MySQL database, as well as DHTML and Javascript.

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