E-Learning Cafe in University of Porto: ICT influence in the design of social learning spaces

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The present research project is three-fold:

(i)   to upgrade and transform an unused university building into a new social and study space, taking advantage of ICT functionalities by integrating them into the proposed design and by using them as active communication tools within the design process;

(ii)   (ii) to monitor the use of ICT along the design process as an important communication tool for all the players involved (design team and potential users of that space);

(iii)   (iii) to monitor how this new space is perceived and utilized by the university population;

The overall aim of this project is to start creating a set of new dynamic learning spaces that integrate social and study activities and that constitute a strategic relational dimension for all the people working or studying at the University of Porto (U.Porto). In this context, the design of this space has made use of ICT for creating a rich communicational and learning environment, i.e., wireless networking, access to collaborative software, power source for mobile computing devices and other functionalities. Thus the program of this E-Learning Cafe and its spatial configuration and internet site aims to encourage several types of group interaction, both for socializing and studying, to promote interdisciplinary exchange of knowledge and experience and to offer people a set of diverse social and cultural events such as courses, readings, performances, workshops, etc.

The project is still in phase (i), which means that the transformation and renovation of the building is under way and that the first version of the E-Learning Cafe site (http://elearningcafe.up.pt) is already online. Up to now, the site has been used for reaching the following objectives: (1) to communicate and simulate the new E-Learning Cafe design; (2) to inform about the organizational structure and program contents of the E-Learning Cafe and (3) to survey the opinion of the potential users of the E-Learning Cafe space through a short questionnaire which visitors can complete after viewing the explanation and simulation of the proposed design.

The paper first describes the strategy applied for (1) integrating some important ICT functionalities in the design of the E-Learning Cafe space and for (2) using different representation methods and computer visualization techniques to communicate its design. It then proceeds to analyze the results of the questionnaire and the qualitative responses gathered until the present moment. These quantitative and qualitative data provide some positive information about how people perceived and judged both the content (the proposed design) and the form (the representation methods and techniques used for visualizing images). Nevertheless, further data need to be collected and studied in order to draw a set of more reliable conclusions.

1. E-Learning Cafe of *Pólo da Asprela* Design

As Universities face the growing pressure to deliver high standards of education, the efficient and effective use of their physical learning spaces is paramount for being able to provide effective environments and facilities for learning and studying, which attract students in a competitive educational market. The U. Porto campus, through IRICUP (*Instituto de Recursos e Iniciativas Comuns da Universidade do Porto* - Institute of Resources and Common Initiatives of the University of Porto) pretends to offer various types of learning spaces covered by technology within its boundaries: the E-Learning Cafe of *Pólo da Asprela* program is an important step in that direction. This project aims to create a set of new dynamic learning spaces that integrate social and study activities and that constitute a strategic relational dimension for all the people connected in some way with U. Porto. The general objective is to promote different types of communication among the users of university facilities, using ICT as an important means to structure and organize the university space.

The program for E-Learning Cafe and its spatial configuration will encourage several types of group interaction, both for socializing and studying, promoting interdisciplinary exchange of knowledge and experience. This means it will offer people a set of diverse social and cultural events such as courses, readings, performances, workshops and other alike. In fact, these spaces will provide a new environment where social and learning activities are combined. Thus the whole academic community can meet, exchange knowledge, share experiences and work in groups to solve problems, promoting in this way interdisciplinarity and innovation.

One important characteristic of this environment is its physical and virtual nature (the building and its internet site), which, linked together, create a richer relational dimension. The result is communication between people who may be seated far apart and a strong interrelation of ICT with space design, allowing for different types of spatial use and functions.

Some research based design principles for learning environments and settings were taken into account for this design (Sanof 1992; Sanoff 2001). Some of the principles that were taken on board are shown in table ().

1) Stimulating environments	6) Changing displays
2) Places for group learning	7) Resources availability
3) Linking indoor and outdoor places	8) Flexibility
4) Public space	9) Active / passive places
5) Safety	10) The community as a learning environment

Some important aspects of the present E-Learning Cafe design and process were also influenced by several case studies and reports (Denison 2007; Futurelab; infoNet 2007) as well as the writings of other authors (Mitchell 2003; Rudd 2006).

Thus, we took into consideration global aspects as:
Anticipation – thinking that social places should be designed in such a way to encourage people to use them also as learning spaces and that ICT is now and in the future going to play a very important role in the design of those places;
Imagination – using, furniture, flooring, lightning and other architectonic elements to create a strong identity, but leaving spaces open for the institution and the people personalise them in different ways;

Implementation – this meant, besides other things, involving a lot of different people in the project, taking in account the sustainability of the program and integrating ICT functionalities in the process mainly by using them as active communication tools within the design process; *Evaluation* – this means that we will monitor the use of the E-Learning Cafe using its internet site as the main communication platform for giving and receiving information on how this new space is perceived and utilized by the university population.

It is important to say that the design of space has an enormous influence on how people feel and behave in their daily lives, at home, school or work. In fact, architecture has an intellectual content, conveys social meanings and is capable of influencing our physiological and psychological states. Thus, we tried to think on a program of activities that could affect positively the student population and aimed to design a rich, diversified and stimulating space that would encourage social and study activities.

1.1. The program and its design

The new E-Learning Cafe in Campus II of Asprela in U. Porto has as main target its students and the new spatial configuration favours the creation of learning communities within the university campus integrating ICT actively in program's space layout and functions. The program consists of four main interrelated spaces: Cafetaria / Bar room, Multimedia room, Chill-out room and Work / Study room.

Some important factors taken on board were the following: (a) Making sure people with mobility problems could access the space; (b) Refining the acoustics' of the building and (b) creating a dynamic and appellative spatial ambience, using colour and textures to match its program and objectives.

The E-Learning Cafe project took advantage of the open space configuration of the atrium, first floor room and double height ceiling areas of an already existing university building, which was being used erratically as a bar facility for students who were living in a nearby residential unit. The aim of the new design for the interior space of that building was to bring together the students from different departments, promoting the exchange of knowledge, experience, and group work encouraging interdisciplinary discussions between them.

One of the first objectives of this new design was to free the interior space of that building from all of its architectural noise as mismatched colours, textures and materials. The aim was to create a strong coherent and flexible spatial design, linked to the new E-Learning Cafe program. A new set of interrelated spaces, having each one of those places, an individual ambience and design reinforcing its particular purpose or use, and the adoption of solutions that assured easiness for users or programmers to change some characteristics or ambiences of those spaces. This last aspect was important because it gave a greater flexibility for the E-Learning Cafe space to be renovated, making possible for students to personalise certain spaces and change ambiences without compromising the overall unity and architectural coherence of the global space. The different ambiences that are created for each area are mostly the result of thinking the new furniture and its layout as an important spatial design element for characterizing the space and by controlling the natural light and applying different types of artificial lighting to each individual area. The interior building signage is still being studied and the objective is to create a set of strong and clear orientation signs, well integrated in the proposed spatial design, allowing people to easily identify the way to the different

spaces i.e. Cafetaria / Bar room, Multimedia room, Chill-out room and Work / Study room and emergency exits.

The possibility for students to fix, stick or place different letterings or artefacts on many of the walls will hopefully allow them to appropriate the space with their own work and visual language. To facilitate this appropriation and individual characterization of the physical environment we designed the walls and ceiling using white cork material. All of these components have high sound absorbency characteristics that allow to control the sound on the different spaces without having to use doors and therefore with no segmentation of the actual space.

1.1.1. First floor

1.1.1.1. Atrium, access and circulation space

The building has four main entries and we propose a new design for the door openings to match the rest of the building frames', creating a more unified exterior image. Nevertheless, the exterior of the building does not really suffer any change being just subject to some restoration and maintenance work.

Access to the second floor is through two symmetrical stairs positioned on the first floor near the West entrance that gives access to an open garden space. The different spaces on the first floor distribute themselves around a central octagonal atrium. This central area, equipped with some puffs and a multimedia kiosk, links the different ambiences of the rooms and serves as an entrance and distribution hall for the E-Learning Cafe. We propose, for the ground level, a homogeneous floor covering material in grey, which is resistant and easily washable. This neutral surface colour will simultaneously give unity, reinforcing the fluidity of the E-Learning Cafe space, and serve as a background for the different furniture and elements of the other rooms. A new suspended plaster ceiling is applied and we propose also the design of a new door in the West wing corridor entrance and a new set of shelves with two small niches to place a set of vending machines for food and drinks. The access and circulation space has as its most important reference the atrium, which is the central area with double ceiling height and natural lighting and the place were the four corridors that give access to the main entries of the building intersect.

1.1.1.2. Cafeteria / Bar

The new bar is located on the first floor West side and has two main areas: (a) the preparation of food and attendance vicinity and (b) the sitting area located where the ceiling is double height. The bar relates directly with the other informal working areas of this floor, encouraging the use of these spaces both for socializing and studying activities.
In order to create a feeling of shelter in the bar area that has a double height ceiling, we decided to change its scale perception, making the place less visually exposed from the upper floor by placing a set of overhead pendant lights, at the height of about 2,5 meters from the floor. This "rain" of pendent lights fills the volume of space in this very large room and will visually 'draw down' its high ceiling and help to define and delineate the bar zone, adding a certain intimacy to it.
The green colour was chosen for the table furniture thinking on its tranquilizing and calm properties so important for people to relax. The walls, as was already pointed out, allow for students to personalize them with graphic material or other type of information.

1.1.1.3. Multimedia room

This multifunctional space, located on the first floor West side, has also a double height ceiling and was designed to be the heart of all the performances and activities taking place in E-Learning Cafe that aim to animate and give a strong dynamic to this place. The objective is to manipulate the natural and artificial light in conjunction with the use of ICT for creating different ambiences and allowing several types of interaction with the people using the place. The pavement is made of the same resistant, washable neutral grey material so that light colours may be projected on top of it and as a result different ambiences are created. The first installation will be an interactive web camera that will capture the movement of people and send a signal for different light colours to be projected in the walls and floor.

When no performance is taking place, a set of informal movable furniture for socializing activities or studying will be put in. This will assure that this area will be always in use and integrated with the different studying areas of the E-Learning Cafe.

1.1.1.4. Elevator for people with motor disabilities

The elevator for people with motor difficulties is located near the atrium, in the area of the North wing corridor.

1.1.1.5. Chill-out room

The objective is to use this South located half moon room both as an informal setting for relaxed and calm socialization and for studying. This strategic area will link the bar and multimedia rooms and will also serve as a transitional zone between the garden outside and the inside area of the building. The room will have a tiled covered floor in a resistant and textured material, a white plaster ceiling and its wall surfaces will also allow students to personalise them. The furniture for this room consists of a set of sitting pillows and small table furniture for working with laptops. In this way, we give a great freedom for users to organize and locate themselves both inside the building or outside in the garden.

1.1.1.6. Bathroom facilities

Bathrooms are located in South East sector and these facilities are prepared to serve people with motor difficulties. The colour of the bathroom furniture will be predominantly in blue.

1.1.1.7. Maintenance and take over material facilities

This area is located in the North east sector and the space is subdivided in 5 main areas: the delivery and take over area, the room for security guard, maintenance room, stocking room and server room.

1.2. Second floor

1.2.1.1. Working room

The working room area occupies the second floor and it is an open space designed to allow a set of different ambience / facility settings: an area with fixed computers distributed longitudinally in rectangular tables for individual work and an area for group work with

circular tables topped by suspended acoustic lump domes and other more informal and less specific places.

The lightening and colours of the furniture will characterize differently these two ambiences. Thus the fixed computers area for individual work is characterised predominantly by the blue colour and table lamps to give light in each individual table allowing the user to control at his will the light intensity. The working group area adopted orange to signal its different use and to obtain a higher diffusion of the light from the domes. The blue chromatic characteristics were thought as good for calming the mind and giving concentration and orange was believed to stimulate students, triggering their motivation for group work.

2. E-Learning Cafe website

The E-Learning Cafe of *Pólo da Asprela* is a dynamic space that offers a new type of environment that integrates actively its website as a complementary virtual space that interacts with all its potential users and creates important links to the building. The website will facilitate and promote interaction and communication of students and other users and will serve as an important communication and participatory platform for different academic communities to exchange knowledge, share experiences and carry out a wide range of activities. The website will have a dynamic calendar to keep people regularly informed about what is going on at the E-Learning Cafe. Live events as concerts and performances can be video recorded in real time by video cameras and have the participation of other E-Learning Cafe or other socializing places located else ware. The website will announce all the cultural activities, workshops, exhibitions and other significant events that are to take place within this project and will give all the formal and institutional information needed. The website will also establish links to several departments of U. Porto and allow people to register their opinion about different issues and contact the E-Learning Cafe website managers.

2.1.Layout and website navigation structure

The following structure (Figure 2.1a) was applied to the E-Learning Cafe website:

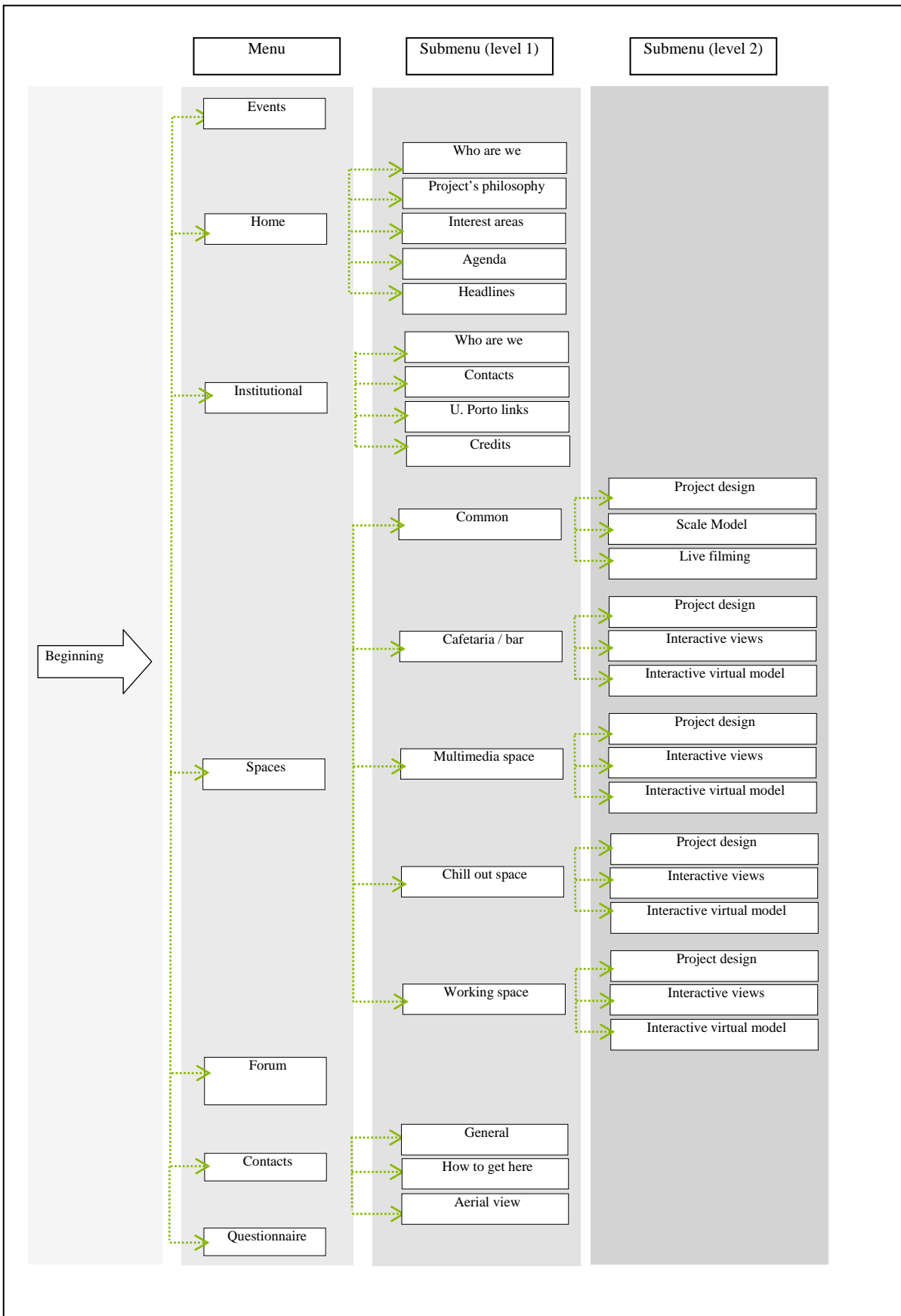| Menu	Submenu (level 1)	Submenu (level 2)
Events		
Home	Who are we	
	Project's philosophy	
	Interest areas	
	Agenda	
	Headlines	
Institutional	Who are we	
	Contacts	
	U. Porto links	
	Credits	
Spaces	Common	Project design
		Scale Model
		Live filming
	Cafetaria / bar	Project design
		Interactive views
		Interactive virtual model
	Multimedia space	Project design
		Interactive views
		Interactive virtual model
	Chill out space	Project design
		Interactive views
		Interactive virtual model
	Working space	Project design
		Interactive views
		Interactive virtual model
Forum		
Contacts	General	
	How to get here	
	Aerial view	
Questionnaire		

Beginning

Figure 2.1a: Web site structure and content

The website creation took on board the opinion on several matters coming from people belonging to different university departments and its development implied significant group work and interdisciplinary discussions. The main users of the website were considered to be the university students and the website structure, graphic identity, dynamics and interaction level were thought for being used primarily by this group of people. The students, in general terms, are young and have a good or medium familiarity with internet, thus the dynamic and interactive characteristics of the E-Learning Cafe website layout (Figure 2.1b) aim to induce these potential users to explore the platform. This meant, besides other things, using animation for navigating through the several menus and allowing the user to freely go to any section without having to visit the preceding one.
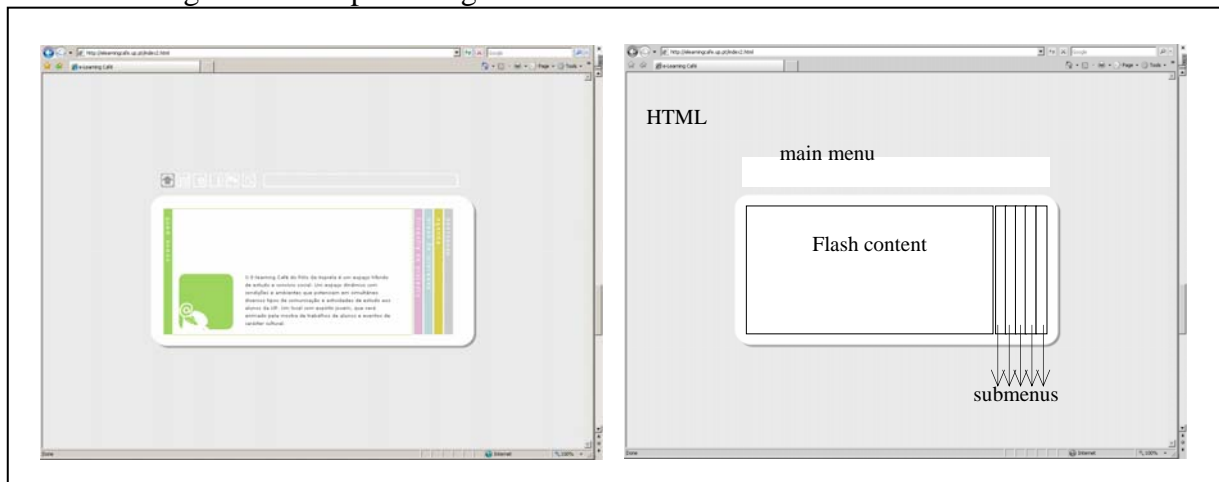

Fig 2.1b: General layout of the site

2.2. Design communication model: visualization techniques, representation methods and interaction level for communicating the new design

In the last decades ICT developments have influenced and changed society in general. Internet communication has altered in many ways how people communicate, allowing individuals that are far apart to socialize and exchange information in new ways (Rudd 2006). All this has had a tremendous impact in various fields and the present research project had in mind, besides integrating computer technology in the proposed design for the E-learning Cafe, to communicate and simulate this design through the website of the E-learning Cafe. In fact, we wanted the design for this E-Learning Cafe to be the subject of wide debate and effective communication techniques. The outcome of this communication will benefit both the design and the U. Porto Campus as a whole. This is so because in this way we are increasing the consciousness and responsibility of users in the process of design making, so the communication of the proposed design was integrated in the E-Learning Cafe website, creating two important sections *Espaços* – Spaces – and *Participação* – Participation. The section called *Espaços* uses different visualization techniques and representation methods to communicate the E-Learning Cafe design proposal to all its potential users and has a questionnaire linked to it so that we gather information about what people understood and thought about the proposed design and the website. It is subdivided in 5 submenus: The first submenu concerns the overall space of the building and the other four submenus communicate the design and program for each of the following specific spaces of the E-Learning Cafe – Cafetaria, Multimedia space, Chill out space and working space. The second section

Participação allows for anyone to register their opinion about the E-Learning Cafe program or about any other issue that they may want to draw attention to.

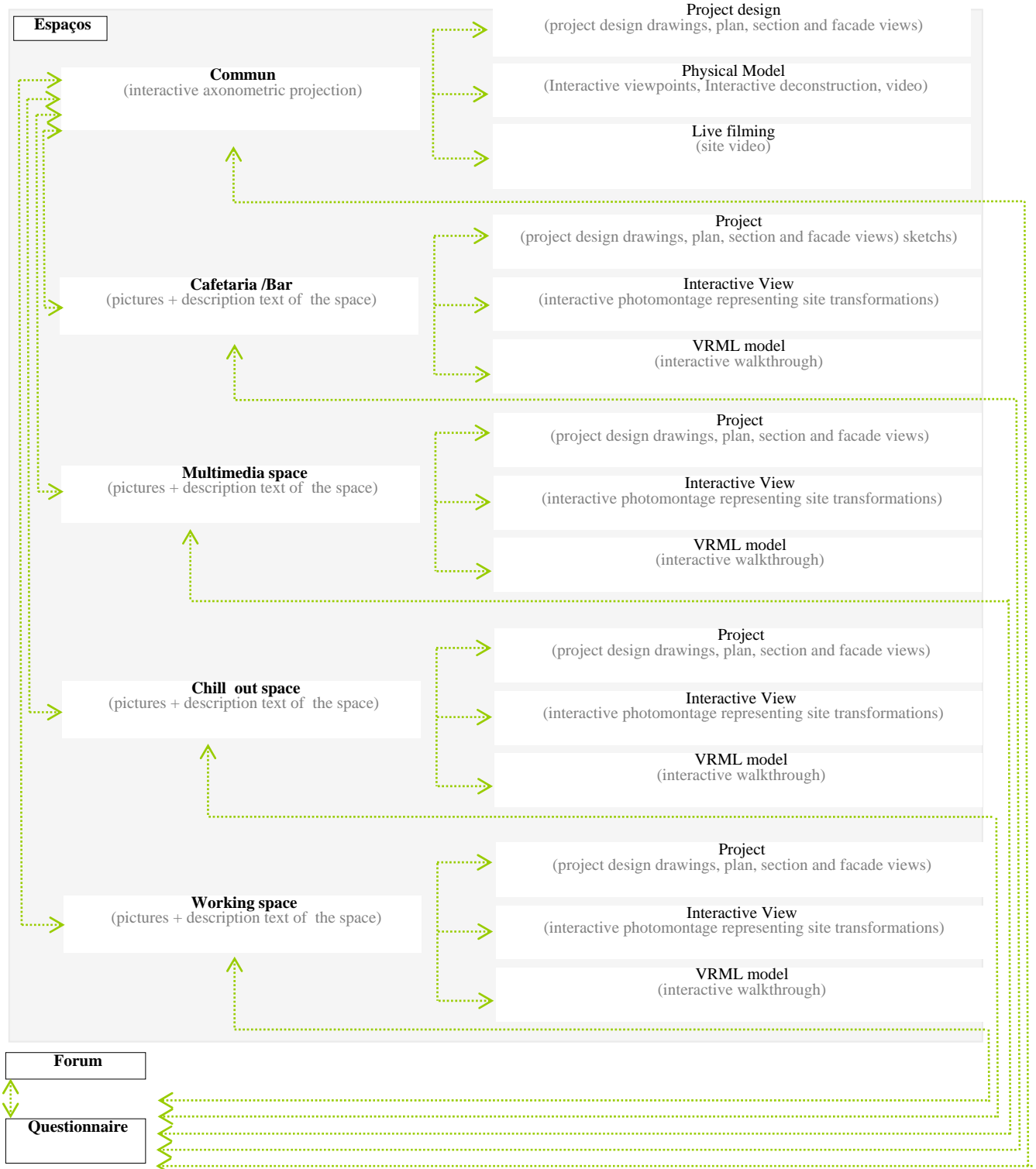We present in Figure 2.2 the design communication layout and structure.

Figure 2.2: Communication layout and structure

In order to achieve an effective communication we explored the interactive potential of internet and used the digital representation of space and computer visualization carefully and sensibly so that their potential would not be undermined by dumbing-down the design communication with excessive emphasis on imagery (Richens & Trinder, 1999; Cambridge Futures, 2004). In fact, an excessive emphasis on visualization and imagery can impoverish design communication (Bourdakis, 1997; Koutamanis, 1997). Thus the website informed extensively about the E-learning program and activities and both realistic and abstract representations were used to communicate its design in order that both the specialists and the lay people could understand better what was being proposed.

The use of different levels of abstraction is also linked to the type of information to be communicated. This means, for example, that abstract representation methods were used for revealing the underlying spatial structure of reality and the basis of design intervention. Other more realistic representations were used to engage the users more strongly on what was being proposed and on assisting the understanding and communication of the design to them. Video and animation can make a useful contribution to make a communication exercise realistic and engaging. The way these different representation methods and computer visualization techniques were interrelated and the level and type of interaction that was made possible with them was thought with the objective of allowing the users to perceive different view points and aspects of the design and interrelate them in various ways.

Furthermore, it is now possible to address the human senses more strongly and obtain a very powerful engagement from people, especially when the simulation of space involves the activation of their haptic and basic orienting systems (Steur, 1992). Spatial memory is a complex collection of cognitive processes and skills (Koutamanis, 1997) and not just dependent on vision. Accordingly, the capacity that any communication medium may have for producing a sensorial rich mediated environment (vividness), and the degree to which the users can influence the form or content of the mediated environment (interactivity) seem to be critical (Sheriden, 1992; Steur, 1992). For these reasons, we used a VRML model of the proposed design, allowing the users to visit and interact with this 3D simulation of the interior space, allowing them to have a more engaging and convincing simulated experience of the proposed physical environment and also to go beyond the perspective grid, allowing users to perceive the proposed design in a new way.

It is important to point out that allowing the viewer to interact with the model has proved to be an important aspect of design communication (Hall, 1996). While this interaction can occur in many ways, for example, in non-virtual meetings between designers and clients where a computer model is used to explain the design or through the use of the internet, i.e. see Richens & Trinder (1999), in our case it occurred mainly through the website and the built operators for communicating the proposed design. This interaction – allowing users to analyse the different views, models and representation methods of the proposed design and to register their opinion on the website – was possible to implement and is the result of exploring present ITC potentialities for communicating new design through the internet.

Other issues apart from aspects to do with built form and its realistic representation were communicated, trying to achieve a good balance between 'image' and 'content' and making an effort to communicate the E-Learning Cafe as a process that is not just construction and a matter of the appearance of the design. In addition, as was already pointed out, the whole design process of the E-Learning Cafe implied several types of meetings, involving several

representatives of the U. Porto and using various forms of communication supports — digital and non-digital — i.e. card-board model, virtual internet-based communication and non-virtual public meetings.

2.2.1. Aspects and rationale for using each representation method and techniques for visualizing images

When communicating the new design of the E-Learning Cafe, we payed attention to the following factors for each representation method and visualisation technique that was applied.

2.2.1.1. Axonometric projection

The axonometric projection representation allowed the vieweres to understand in an abstract way where each different space and function is localised. This representation method places the observer in infinity and shows an image of an object as viewed from a skew direction in order to reveal all three directions of space in one picture. This allows to represent the different spaces and their functions as a three dimensional diagram, making it more easy to grasp their position and relation in space.

2.2.1.2. Plan, section and facade views

The plan views, sections and facades were used to communicate the underlying rationale of the proposal. Issues of space configuration were the main focus when using these central projections, allowing the complexity of reality to be reduced to clearly communicable measurements, relations and proportions within a 2D world. We used plans, sections and facades side by side and linked these interactively to each other and to other type of representations in 3D in order to allow users to analyse different relations and aspects of the proposed design.

2.2.1.3. Perspective sketches

The perspective sketches allowed the viewer to have a closer experience of the space than other more abstract representations. In other words, the 3D of perspective representation and its graphical characteristics of an incomplete draught tried to represent key spatial features with a certain level of realism, even though not with greater precision or detail. The focus was on illustrating how the new interior design would be perceived at eyelevel from different viewpoints and the sketches reflect the architects spatial intuitions and ideas.

2.2.1.4. Building / site photography

The bird eye and eye level photographic images were taken with a semi-professional camera and these static views allowed the viewer to study the site and building, which was the object of the design proposal, in a a more reflexive and calm way than the video films. These images also allowed the viewer to perceive those spaces and objects in a more impressive, expressive or realistic mode than other more abstract representation methods.

2.2.1.5. Photomontage

Photomontage allowed the viewer to evaluate better the impact of the design proposal for that place. This was achieved by integrating photography and 3D rendered images, simulating in this way the new design. We used the photomontage technique with an interactive panoramic view in such a way to allow the viewer the interactive control of the fading overlaid two

images – the image of the place before proposed design and the 3D rendered model of the proposed design.

2.2.1.6. Building / site video

The live filming allowed the viewer to perceive the E-Learning Cafe building before the new design as if he/she were at the site. It was important to show the site and the building from several viewpoints and with various kinds of camera/lens movement and to focus on different areas of the building. This ensured that people would have a chance to feel the area, the people and perceive both the urban configuration and the formal properties of the interior and exterior space of the building before the new design took place.

2.2.1.7. Physical model video

The physical model video allowed the viewer to perceive aspects of the proposed new design that are closer to the experience that he/she would have if visiting a model with a scale of 1:1. This is so because we used a webcam to enter inside the model and this camera was positioned at the same height as a person at that model's scale - 1:50. It was important to show different paths inside the model, varying the speed, time and light of the camera. This gave a different perspective giving information to viewers that could be used in conjunction with the other representation methods and visualising techniques in order to obtain an enriched point of view of the proposed design. Nevertheless, this procedure must be refined because the results obtained were still somewhat cumbersome.

2.2.1.8. Computer 3D realistic model images

Computer 3D realistic model images, also known as Photo Real Renderings were obtained by a 3D modelling and rendering software. The objective was to create life-like images that could be used for analysis purposes and the 3D model was created to the right proportion, scale and even used some real life textures, materials, colour and finishes.

2.2.1.9. Computer 3D abstract model images

Computer 3D abstract model images were obtained by the same 3D modelling and rendering software. The objective was to create abstract 3D images that could be used for analysis purposes more concerned with spatial proportions, dimensions and the objects localisation than in illustrating the colour and textures of the proposed design. The 3D model was also created to the right proportion and scale.

2.2.1.10. VRML model

The VRML 3D rendered model helped the viewers to sense the design proposal in a way that more closely matched what they might experience when walking through the site. In this case, we used an abstract 3D rendered model where colour, texture and light of surfaces did not try to mimic reality. Nevertheless, the kinaesthetic and spatio-temporal characteristics given by the interactive walk-through motion were the characteristics which contributed to a higher level of realism. The walk-through paths that viewers would decide to perform allowed them to anlyse and understand the proposed design with great freedom and richness of possible viewpoints.

2.2.1.11. Interactive viewpoints and deconstruction of physical model

Different viewpoints of the physical model could be obtained interactively by moving the mouse in the screen and a menu with buttons for zooming and panning allowed different perspectives of the model. These visualisation possibilities were created using specific software - QuickTime 7 - and allowed the viewer to have a dynamic, interactive 3D perception of different viewpoints and detail of the proposed design based on the 1:50 physical model.

The interactive physical model operator, created with html, allowed the viewer to obtain with a click of the mouse different levels of detail or information of the interior of the building and its design.

3. Method and Questionnaire

An electronic questionnaire that is accessed by a link in the website was the basic method chosen to collect the opinion of users in respect to visualization techniques and representation methods that were used to communicate the new design and other aspects of the E-Learning Cafe website.

A group of closed-ended responses was included at the beginning of the questionnaire, with the aim of accessing some personal and course of study information.

Ordinal scales were used in the questionnaire to obtain the users evaluation on several aspects of the website, visualization techniques and representation methods that were used. Thus, for example, the respondents had to classify several aspects within a five-point scale, placing the corresponding number in a box. The weights of the numbers were as follows: 1 – Very good; 2 – Good; 3 – Neither good nor bad; 4 – Bad; 5 – Very bad.

The nominal level was selected for the questions that enabled classification of the respondents into two or more groups in relation to various aspects, for example, course study or gender.

In order to have the users' qualitative evaluation the questionnaire had several open-ended questions.

For the purpose of this study, taking into consideration the type of data available (ordinal, nominal, non-parametric) and the format of the questions, frequency distributions, cross-tabulations, bivariate and non-parametric test analysis were used (to see the questionnaire go to http://elearningcafe.up.pt/).

As was already referred, the second section *Participação* was created to allow for anyone to register their opinion about the E-Learning Cafe program or other issues that they thought would be worth talking about. This section of the website also made possible to all the users of the E-Learning Cafe to register and place their opinion about the design communication or any other aspect of the E-Learning Cafe program and website. This section of the website was created with Word Press and Figure 3 shows its layout.

Fig 3: The E-Learning Cafe section *Participação*

3.1.Results

We start by pointing out that we are in a very initial stage of the monitoring process and still have not a sufficient number of questionnaires completed for a significant analysis of the results: only 40 respondents. Nevertheless, the results obtained and its analysis at this stage is presented next.

3.1.1. Visual representation techniques, techniques for visualizing images and interaction modes.

People were asked to rate each visual representation technique, each technique for visualising images and each interaction mode according to its importance for communicating the E-Learning Cafe design proposal.

A significant percentage of people rate as the most important visual representation techniques for communicating a design proposal (with a mode of 1 = very important) the following set of techniques:

(a) Building / site photography (valid percent 54,1);
(b) Orthogonal projection: plan, section and facade views (valid percent 48,6);
(c) Computer 3D realistic model images (valid percent 40,5)
(d) Building / site video (valid percent 35,1)
(e) Photomontage (valid percent 32,4)

A significant percentage of people rate as the most important interaction mode for communicating a design proposal (with a mode of 1 = very important) the following techniques:

(a) Interactive walkthrough (valid percent 40, 0).

A significant percentage of people rate as the most important techniques for visualizing images for communicating a design proposal (with a mode of 2 = important) the following set of techniques:

(a) One image at a time on the screen (valid percent 52,4);
(b) Images side by side on the screen (52,4);
(c) Fading overlaid images on the screen (38,1);
(d) All of the three techniques (valid percent 36,8)

When asked to rate each type of representation according to its technical and artistic quality (with a mode of 1 = very good, mode of 2 = good and mode of 3 = neither good or bad), the results are the following:

(a) Axonometric projection ; (very good, valid percent 35,0; good, valid percent 27,8);
(b) Orthogonal projection: plan, section and facade views; (very good, valid percent 36,1; good, valid percent 41,7);
(c) Perspective sketches; (very good, valid percent 5,6; good, valid percent 36,1);
(d) Building / site photography; (very good, valid percent 30,6; good, valid percent 55,6);
(e) Physical model photography; (very good, valid percent 30,6; good, valid percent 33,3);
(f) Photomontage; (very good, valid percent 25,0; good, valid percent 38,9);
(g) Building / site video; (good, valid percent 47,2; neither good or bad, valid percent 30,6);
(h) Physical model video; (good, valid percent 36,1; neither good or bad, valid percent 44,4);
(i) Computer 3D realistic model images; (very good, valid percent 38,9; good, valid percent 33,3);
(j) Computer 3D abstract model images; (good, valid percent 38,9; neither good or bad, valid percent 44,4);
(k) VRML model; (good, valid percent 52,8; neither good or bad, valid percent 19,4)

The valid percent for a mode of 4 = bad was never more than 4, 0 and the mode of 5 = very bad was never used.

3.1.2. Program, design and website of E-Learning Cafe

When asked their opinion about the new interior design for the E-Learning Cafe space (with a mode of 1 = very good, mode of 2 = good and mode of 3 + neither good or bad), the results were the following:

(a) good, valid percent 54,1;
(b) very good, valid percent 37,8;
(c) neither good or bad, valid percent 7,5

 When asked their opinion about how important the E-Learning Cafe program is for the UP students, the results were the following:

(a) very good, valid percent 59,5;
(b) good, valid percent 32,5;
(c) neither good or bad, valid percent 5,0

When asked about the E-Learning Cafe website potential for communicating and interacting with UP community, the results were the following:

(d) good, valid percent 51,9;
(e) very good, valid percent 40,7;
(f) neither good or bad, valid percent 7,4

3.1.3. Qualitative questions

Looking at the qualitative questions that were obtained in relation to the importance of E-Learning Cafe for the U. Porto, the majority of people answered positively. This means, for example, that people are convinced that the E-Learning Cafe and its program is of significant importance for breaking the lack of communication between the different departments of U. Porto i.e. "… because it will facilitate the communication between the people of several departments…"; "… because it constitutes a space of U. Porto where people are encouraged to exchange ideas, participate in various activities, socialize and learn…".

When asked to explain the reasons for evaluating the potential of the E-Learning Cafe website for communicating and interacting with U. Porto community the majority of people also gave positive answered. Nevertheless, some interesting and important aspects were pointed out. Accordingly most people thought that the E-Learning Cafe has a great potential for allowing communication and interaction i.e. "… nothing as an website with these characteristics for enriching students interaction and communication…". On the other hand, some people expressed their lack of trust on the capacity of the questionnaire for evaluating the design proposal and the representation methods and techniques used to simulate and communicate it i.e. … the questionnaire raises some doubts in relation to how efficiently we can evaluate the proposed design by these methods…".

Then, when asked to write any comments that people felt could be useful for the questionnaire, some interesting and important answers were, for example, that "… U. Porto with this new program could enrich and drive different and interesting activities for all the students….", "… that by doing this they were reinforcing the creativity of students and encouraging them to work and to learn more…".

Finally, looking into the website forum *Participação*, which is also in the beginning, we can see that people are very interested to know more about the design project and to pinpoint an exact date for its opening.

3.2. Conclusions

In our contemporary societies, any public building or public space design should try to integrate in its process the main users of those spaces. This integration benefits both architecture and society as a whole because it allows increased consciousness and responsibility from the people who are going to be more affected or influenced by the use of those spaces or buildings. The E-Learning Cafe program, besides other things, is a first step in U. Porto for showing how ICT can be used to achieve a better communication between all the university population and, in this specific case, to communicate the E-Learning Cafe program and design to them and to have their feedback over these matters.

This integration of end-users should be understood as an incorporated action between all the actors involved in the whole communication process so that people are encouraged to study and analyse the proposals at greater length and promote their discussion within the design process. When this happens, and end-users input is integrated, we enrich the communication and discussion of the spatial program and create a more democratic and participative context where the design making takes place.

It is important to point out that although the communication of the E-Learning Cafe program and its design should have taken place in an earlier stage, securing in that way a more complete and effective communication between all the actors of the design process, it still constitutes an important and significant example of the potentialities of enriching communication within this process and of how ICT can help in achieving these objectives. The E-Learning Cafe design is still open to some modification. In fact, there is still the time and the will to incorporate in its architecture and program many ideas and aspects that may be pointed out in the questionnaires or in the participatory forum of its website.

Even though the number of people that completed the questionnaires and participated in the E-Learning Cafe forum - *Participação* - is still not representative at this stage, analysing their input has showed us, besides other things, the following. First, that people in general, and students in special, want to have information and are interested in new programs and facilities that are proposed for them in U. Porto campus. Secondly, those students can be positively critical in relation to how U. Porto facilities are presently managed. For example, they indicate that this type of program should have been implemented in U. Porto a long time ago, but point out that doing it now is something very good and necessary. They also can point out factors or situations that they perceive as negative, as certain places in the university campus that could have better use. Finally, that they are also capable of recognising positive points, especially about the importance of the E-Learning Cafe program for U. Porto population and their particular needs as students.

In relation to qualitative answers in questionnaire, and their opinion about the proposed design, its program and the E-Learning Cafe website, although their number is also not representative at this stage, we can detect the following most important aspects. That people, in general, consider the proposed E-Learning Cafe design good and are very keen and interested to know more about the space and the various proposed activities for it. They also had a very positive opinion about the program and thought the E-Learning Cafe website as a great potential for enriching communication and interaction between all the people some way involved in U. Porto campus.

In relation to the importance given to the different type of visual representation techniques, techniques for visualizing images and interaction modes, although the number of records is still dim, we can conclude the following. That in general, people think that both abstract and realistic representation methods and techniques for visualising images are important when communicating design i.e. majority thought the photography of the site very important and significant percentage (48,6) though orthogonal projection methods also very important. Then, it is still early to study the differences that may exist between different groups of people – especially people with more design training compared with those with less design training.

It also seems that some important ideas coming from past research focused on design communication and representation methods (Neto 2006) were reinforced. These are, in the first place, that reality is too complex a phenomenon to be completely simulated by any one type of representation method. This is one of the main reasons for using various and different techniques and methods when communicating design. People also confirmed their liking for various methods and representation techniques. In fact, as we have already explained before (Neto, 2006), people can follow one or the other of two ways of understanding space or new design. In the case of the detached viewer, the emphasis is on analysing abstract aspects of space (e.g. spatial configuration). In the case of the behaviourist approach, the viewer perceives reality through the active experience of being part of it (e.g. sensing the rhythm of

passing urban elements as she/he strolls along a pedestrian path). In order to communicate effectively to both professionals and lay people, we must not fall too much into just one of these modes (e.g. it seems design professionals tend to better understand and to give more importance to conventional and abstract representation methods, while other people do not). Accordingly, the design presentation should address these two ways of understanding reality, which means allowing people to both understand the logic and perceive the space of the new design. This means, among other things, using both realistic and abstract representation methods in an integrated and balanced way. This was what was done in this case, with the use of different representation methods and several techniques for visualising images and offering several interaction modes. These techniques and interaction modes were considered also very important for communicating design and allowing users to study, explore and understand better what is being proposed to them. Displaying one image at a time and images side by side on the screen where the techniques considered very important by the majority of people. The interactive walkthrough was considered as the most important mode of interaction (valid percent of 40,0).

Thus, when we think on the E-Learning Cafe website and our present communication exercise, we see reinforced, among other things, the idea that the WWW and computers can assist in the integration of end-users and other actors in the planning and design process. This is so mainly because of its potential for reaching people, allowing them various degrees of interaction, visualisations and simulations, making clearer what is being proposed to them and letting people in this way to play a more active role in the whole process (Batty, 1995; Hall, 1996; Batty *et all*, 1999).

Thinking in global terms, we support several formal and informal presentations at several stages of the design process and a better integration of the potential of the digital platform and computer visualisation in all of those stages. For instance, we advocate that the use of the WWW and the interactive potentialities of computer display or software should be more widespread, so that they can play a more important role in enriching design communication and especially public or end-users participation. This means, among other things, using the WWW to reach more easily all the actors in the design process, allowing wider discussion and communication to take place regarding the planning and design proposals. Also, to use the potential of computer visualisation, especially their interactive displays, to allow people to analyse and explore with greater freedom the proposed design. This could be done, for example, placing this interactive technology in prior advertised public spaces or using them for specific public gatherings. These possibilities and others as the use of ICT, after the design is concluded, to interact with the real space and to promote communication with people that may be located very far away from the E-Learning Cafe will be persuaded.

To finalize, we point out that the next important steps to be taken in order to advance on this research will imply the active use of its website to monitor the program and the building of the E-Learning Cafe. This means to try and answer, for example, the difficulty of ascertaining "…the extent to which behaviour in the virtual world environment is directly transferable to the real" as Batty *et al.* (1998, p. 1-2) have pointed. For this we need to confront the expectations of people and results obtained in questionnaire with their opinion after visiting and using the E-Learning Cafe building. The website will continue to serve as an important support and means for establishing communication with end-users at various levels, allowing the monitoring of the building in relation to different issues and also to evolve in many aspects of the E-Learning Cafe site.

3.2.1. Research limitations and future work

All research has its limitations, and the present research, especially at this stage, has been limited by factors of time and financial resources. These limitations resulted in the fact that the E-Learning Cafe website and communication exercise could not be completed in a much earlier date. If there had been more time, it would have been possible to use more effectively the input obtained by potential end-users of the E-Learning Cafe program.

Nevertheless, changes may still be made based upon the feedback and interaction that is established with the end-users through the website, its communication exercise and questionnaire. Most important, the work developed until now has proved to be a very significant example for the future development of the present E-Learning Cafe and other similar programs to be implemented in U. Porto Campus.

Then, mostly due to financial constraints and lack of human resources, the videos have some technical problems that could otherwise have been resolved. The VRML model is still also in a somewhat early stage. Nevertheless, all these aspects are going to be addressed in the near future and serve also to demonstrate the difficulty to produce a high level of technical perfection when various constraints related to representing and simulating a design proposal exist as in this case.

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