# Learner Centred Virtual Environments as Places

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## Introduction

In this paper, we consider the importance of place in learning and present a virtual campus developed as a learner centred virtual environment. This approach is based on a constructivist view of learning with values and theories including "collaboration, personal autonomy, generativity, reflectivity, active engagement, personal relevance, and pluralism" (Lebow,1993). In order to achieve a constructivist learning environment, we focus on the design of a place for learning in which the learner can modify and construct external representations of knowledge.

Virtual Learning Environments are not easily defined. The term virtual learning environment is commonly used to describe software that resides on a server and is designed to manage or administer: various aspects of learning; delivery of materials; student tracking; assessment; and so on. There are now many commercial Virtual Learning Environments available out of the box, of of which offer a similar set of features. These Virtual Learning Environments typically place the learning material at the centre of the system and provide a set of tools which are of use as the learner progresses through the material. In other words, these systems manage the delivery of the learning material. Examples of such commercial packages include WebCT, TopClass and Lotus Learning Space (Milligan, 1999).

In this paper we seek to bring the focus back to the learner as the centre of the virtual environment and provide them with the facilities to manage their own learning experience. In this kind of environment the learner is able to shape and develop their own knowledge and understanding in a context that is relevant to them. Kolb's experiential learning theory (Kolb, 1993) states that learning is a process whereby knowledge is created through the transformation of experience. Studies into the process of learning, such as those of Piaget, have led to the conclusion that people do learn from their experiences, particularly from their mistakes.

The development of place as the core of a virtual learning environment can provide the basis for a learning experience. Where traditional learning through the distribution of learning materials such as texts and course notes, the presentation of lectures, followed by assignments and tests have been transferred to virtual environments, the development of places for learning is not as well developed. Some examples of places as learning environments are: Diversity University, Tappedin, and the Virtual Campus. Many of these environments focus on the development of rooms and tools for communicating while learning. They do not yet facilitate the learner centred approach that allows the learner to construct external representations of their knowledge.

**Designing the Virtual Campus**

We have developed a framework for the design and representation of computer-support collaborative learning (Maher, 1999) that separates the representation of the learning environment from its implementation, allowing us to focus on the representation of place. We have explored the metaphorical nature of designing virtual places (Li and Maher, 2000) and propose the use of a consistent metaphor as a learning environment. A virtual learning environment that puts the learner in control of the environment, instead of focussing on transferring knowledge to learners, engages learners in a continuous of building and reshaping understanding. A new understanding will occur as a natural consequence of the learner's experiences and authentic interactions with the world (Goddman, 1984; Forman and Pufall, 1988, Fosnot,1989).

The virtual campus approach supports flexible learning by providing a place environment with access to online course materials, other students in the course and instructors. The place concept is similar to the physical campus, providing the interaction and knowledge management framework of the learning space. The place concept offers a consistent frame of reference in the information space of an integrated learning environment. The learning environment supports internally both synchronous communication (meetings, seminars and presentations, collaborative development activities) and asynchronous communication (email and telegrams, bulletin and white boards), in addition to access to course materials, quizzes, project data, student monitoring and evaluation facilities.

The integration of the two complementary models of the place with online learning materials extends the range of supported learning designs, including:

1. Small group learning: seminar style discussion both on-line and face to face, readings, slide presentations.
2. Large group learning: multimedia lecture style presentations available online including slides and corresponding audio and video vignettes, interactive exercises, and quiz assessment.
3. Self-paced constructivist learning: Laboratory style tutorial exercises and project-based assessment, customisable learning materials based on student profile.
4. Collaborative learning groups with access to a range of online materials and specially designed meeting places.

Our virtual campus is organised around the presence of various buildings where each building serves a specific function. The buildings provide office space, seminar space, and library or resource space. The staff and students have personal offices that are either provided for them according to a style consistent with the rest of the campus, or the individual can design and implement his own office. The seminar space is the kind of space we will focus on here.

Figure 1 shows the conference room that is the basis for seminar presentations. This room is typical of the classrooms and is an example of the presentation of the learning space as a 3 dimensional image. The tool bar marked as "1" in figure 1 allows the student to switch his attention from the room view, the slide projector screen, the whiteboard, or the course materials. The window marled "2" in Figure 1 is the current focus of attention. In Figure 1 the focus is on the room view, and in Figure 2 the focus is on the slide projection screen.

The Virtual Campus is implemented in lambdaMOO with the BioGate interface between the MOO database and the web server. The course materials are placed in WebCT, which is automatically launched when the student selects the "book" icon in the toolbar. The Virtual Campus has been used for seminar style classes and virtual design studios. In addition to the Virtual Campus, we have used Active Worlds as a virtual place for learning activities. Figure 3 shows a session in Active Worlds, where the students are represented as avatars.

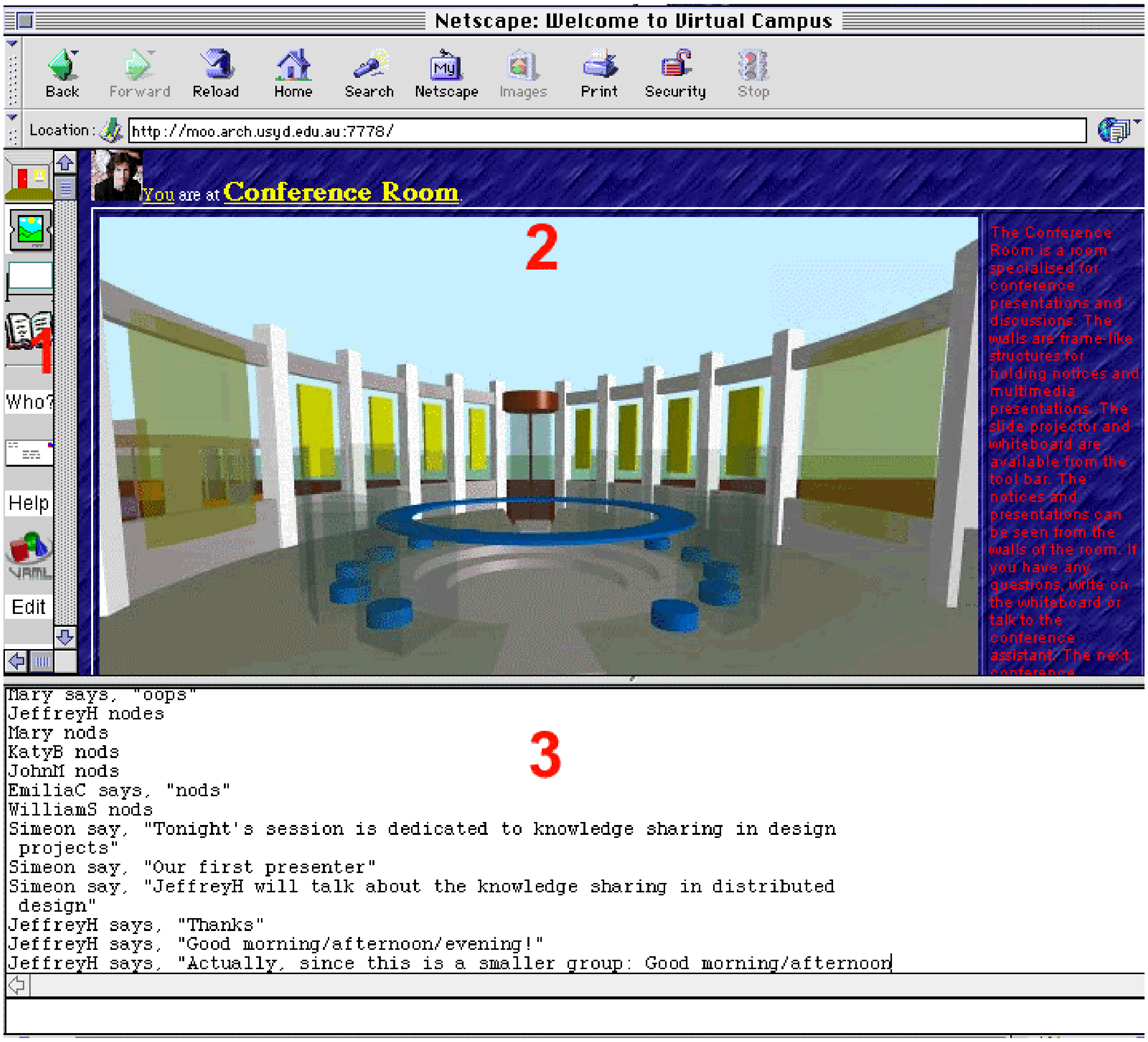



Figure 1. Seminar room in the Virtual Campus

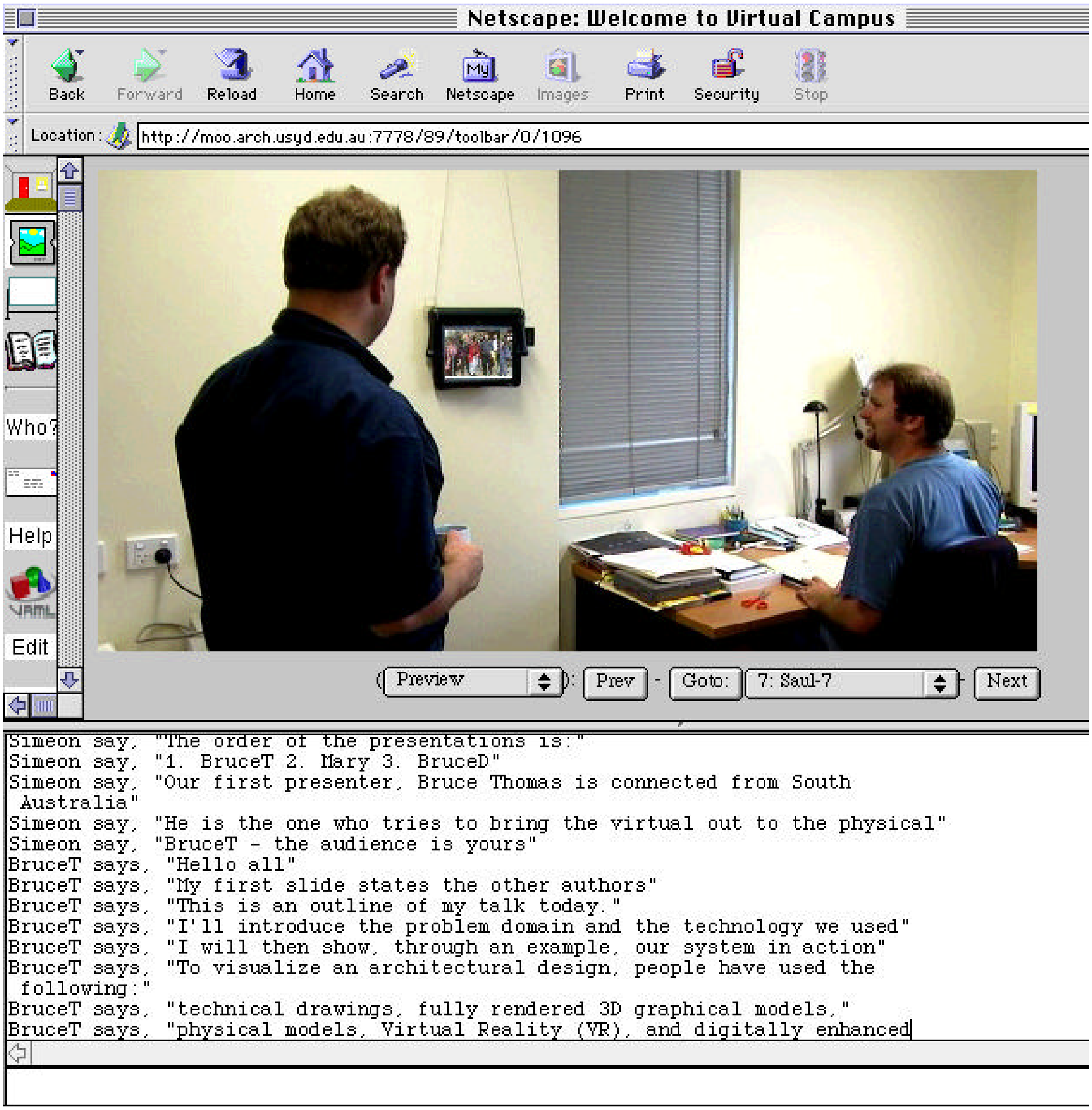



Figure 2. Slide presentation in the Virtual Campus

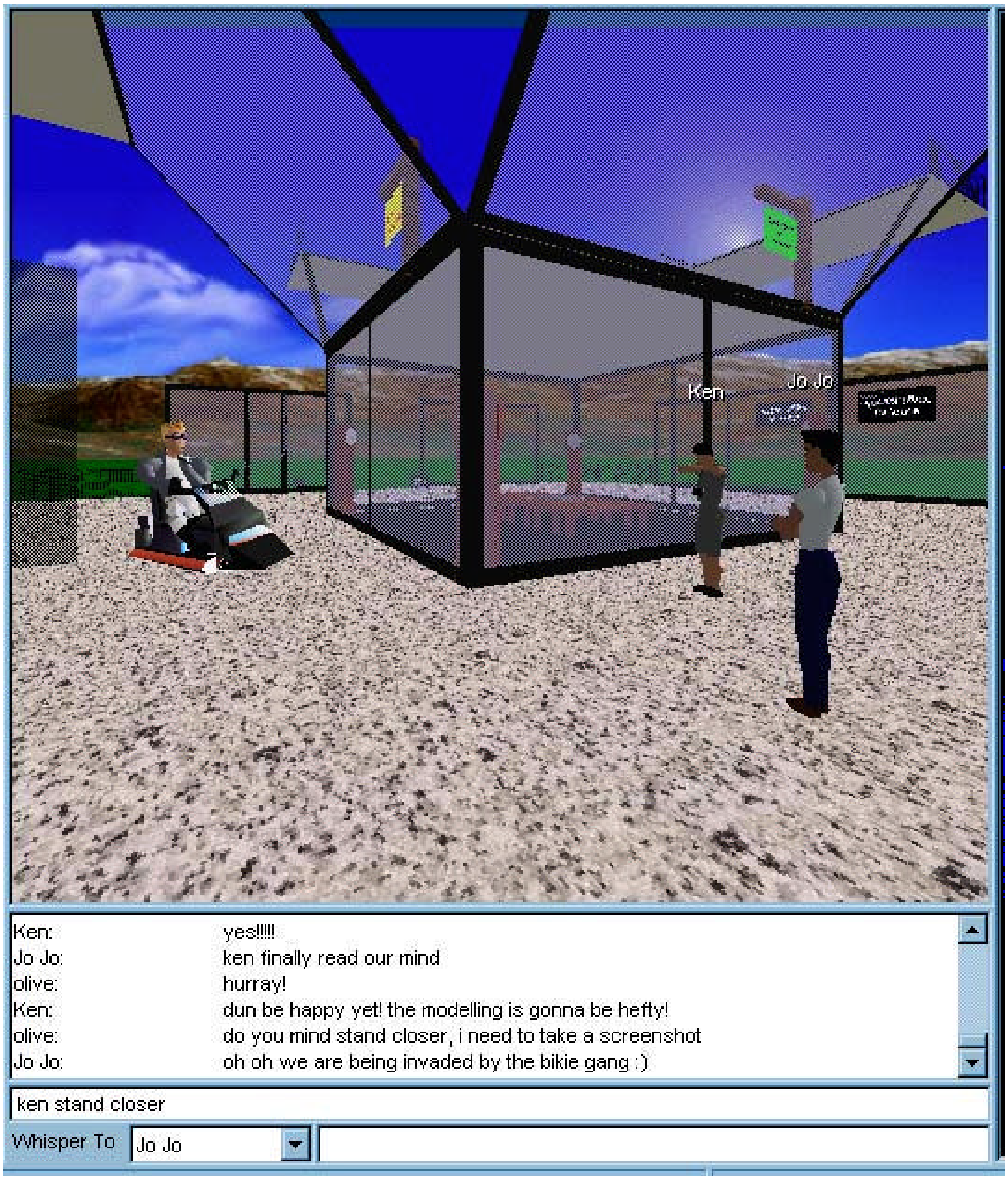


Figure 3. A session in Active Worlds

**Analysis of Communication in the Virtual Campus**

We developed a coding scheme to analyse communication in a virtual place learning environment. Since the students were participating in a collaborative design project, we considered four different coding schemes used in studies of computer-mediated communication and cognitive studies of designers. The first, (See Sudweeks and Albritton, 1996) categorises communication types as follows: *Informal control of communication, formal control of communication, socio-emotional communication, conceptual* *communication, task communication.* The second coding scheme investigates the amount of time spent in computer mediated collaborative sessions 'introducing *new ideas and clarifying those ideas'* (See Olson et al., 1997). The third coding scheme on the other hand classifies interaction between FTF and Video-conferencing technologies by investigating *'Interruptions, overlaps, hand-overs and dominance'* (See O'Connail and Whittaker, 1997). Part of the fourth coding scheme investigated '*low level design'* versus '*high level design'* in computer mediated design sessions with full and limited communication channels (For more details see Vera et al., 1998).

Our coding scheme is made up of four major classifications and in turn some of these are further broken down into sub-categories, illustrated in Figure 4. These classifications are:

1. *'Communication control'*, a category which would help identify differences in how much of the design session was focussed on maintaining the floor, handing over control to another person, interruptions, and acknowledging presence.

2. *'Communication technology'*, a category which looks at discussions held between participants related to the use of the tools and the collaborative environment.

3. *'Social communication'*, a category which looks at the amount of time spent in social talk.

4. *'Design communication'*, a category which first characterises the discussion in terms of 'design ideas', 'design scope' and 'design task'. Within each of these categories, the coding scheme distinguishes different activities in communicating design ideas, the differences and the scope of the discussion, and the time spent organising the design tasks. For a more detailed account see (Gabriel and Maher, 1999).

These categories are not intended to be exhaustive, but to indicate, through analysis, the relative amounts of communication in each category. We are particularly interested in whether the type of virtual environment affects the discussion of design content, and whether there are significant differences in the way communication control occurs in the different collaborative environments. The categories are not exclusive, a single statement could be classified in more than one category.

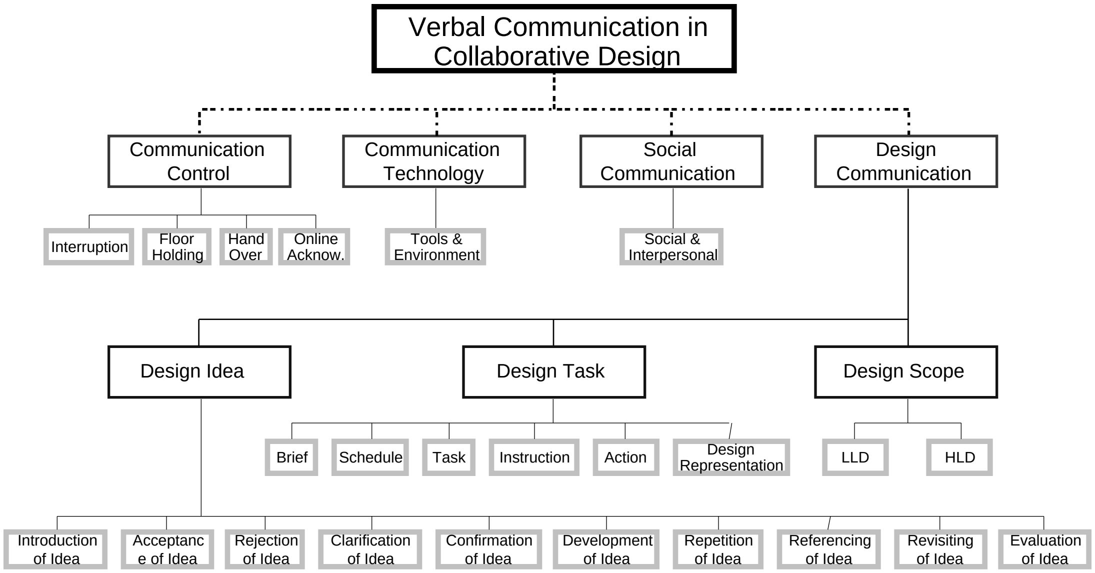



Figure 4. A hierarchical tree of the coding scheme.

The students participated in two types of design sessions: with and without the client[1]). We extended the coding scheme, presented in Figure 3 with two categories - *Communication modality*, with "Addressing all" and "Addressing individual" as subcategories, to capture dynamics within a team; and *Communication for Orientation*, to capture the interactions related to orientation within the information during a participatory session (including the navigation and orientation within the environment and different design representations). Another modification of the original coding schema, is the addition of "Synchronisation" as a subcategory of the *Communication control* category, which depicts moments of synchronisation of the focus of all designers of the team (for example, "Can everyone see the concept drawing?").

The sessions, with and without the client, analysed in this case study have 176 and 466 utterances, respectively. The diagram in Figure 1 shows that the participatory design sessions are characterised by a high proportion of design communication with respect to the other communication categories. The dominant category in the design communication, as illustrated by the diagram in Figure 2a, is the communication of design ideas, combined with high-level (conceptual) design decisions. Gabriel and Maher (1999b) observed similar results in their type-b session where designers used text based communication. To some extent this means that the 3D presence within the design does not decrease the intensity and concentration of text-based communication, identified by Gabriel and Maher (1999b). The higher percentage of task management communication may be due to the teamwork and the length of the design project in comparison with the one-hour duration of experiment 1.

[1] Here we use "client" in broad sense to label *a person or group of people, who formulate the design requirements*, regardless of whether these requirements are software, electrical or mechanical engineering specifications, or a building design brief.

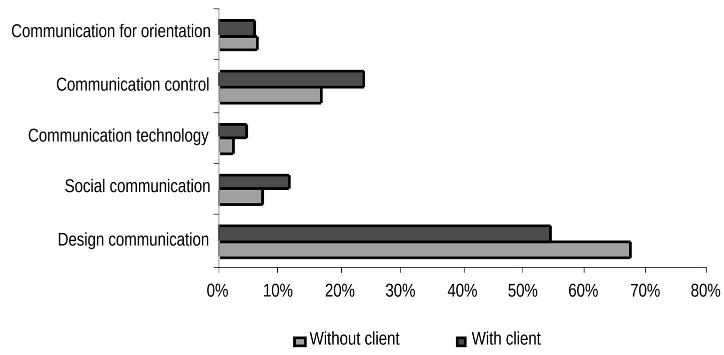
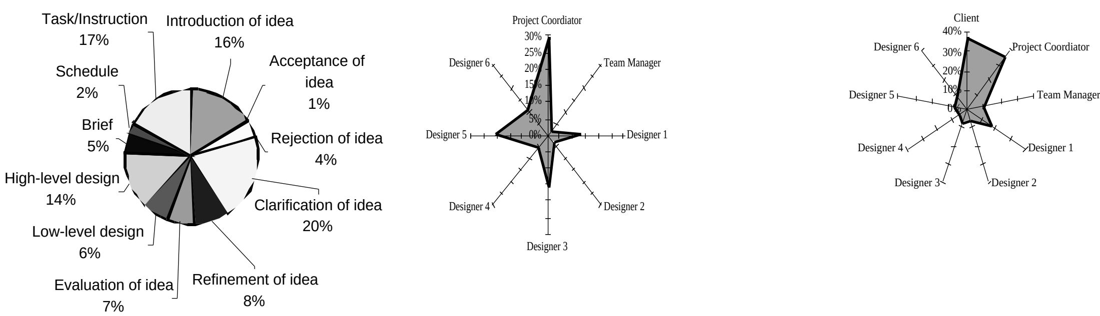



Figure 1. The average percentage of utterances in the major categories in Experiment 2.




a. Design communication b. Participation (without the client) c. Participation (with the client)

Figure 2. Categories and amounts of participatory communication in team meeting

The diagrams in Figure 2b and c present the patterns of individual participation in the participatory sessions without (session 1) and with the client (session 2). Participation is estimated based on the number utterances in all categories, except "Social communication" (for details about the methodology see Simoff and Maher (2000)). Both sessions were connected with conceptual design. In the first session, participants were developing the conceptual design based on the available design descriptions and requirements. In the second session, the design concepts were revised and reinterpreted based on the presentation of the initial design against the design brief and the feedback provided by the client. The patterns in Figure 2b and c shows that during session 1 designers demonstrated relatively higher relevant activity in comparison to session 2. The pattern can be explained with the 3D presence within the design representation, which allowed designers a fairly economical initial presentation of the design concepts in the communication transcripts, relying on short references and visual cues. Client phrases like "Do we need to go somewhere to view the concept as you describe it?" (classified in the category "Communication for orientation" in Figure 1) and "Trying to absorb things we're seeing for the first time... :-)" give an idea about the process itself. The extensive participation of the client not only in the evaluation, but actually in the design itself and the refinement of the requirements explains the high percentage of client activities in Figure 2c.

The dynamics of design communication during the design session (session 1) is shown in Figure 3 and Figure 4. These graphs represent parallel timelines (each time point corresponds to an utterance) for each category of design communication. The graph in Figure 3 shows that conceptual participatory design is characterised with fairly intensive introduction and clarification of ideas during almost the whole session. The fairly low final acceptance and rejection of ideas can be explained by the quick visualisation and illustration of the concepts in the 3D design environment. Figure 3 shows that the design communication at the end of the session was focussed on task management (such communication pattern was observed in both sessions).

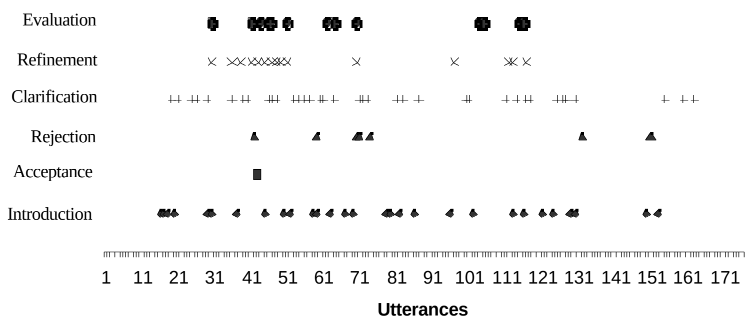



Figure 3. Communication of design ideas during the session.

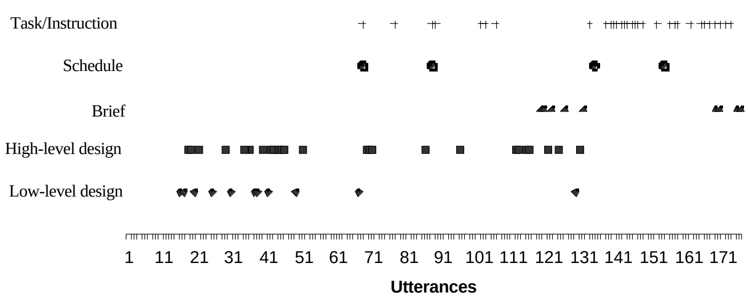
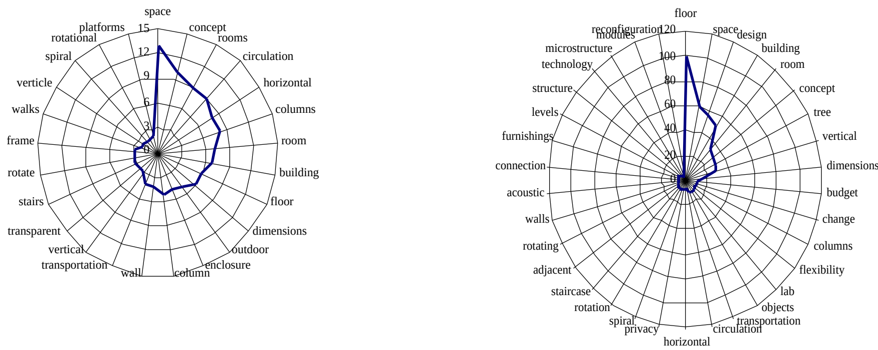



Figure 4. Communication relevant to the design scope and tasks.

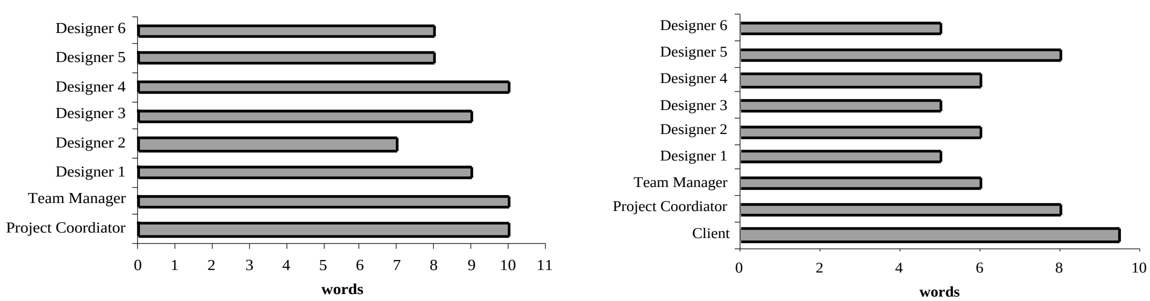
In addition to coding the types of communication, we considered the distribution of communication content by performing a text analysis of the transcript. The major focus of the design team in session 1 was on the concept of a light construct with enhanced circulation. The list of most frequently used concepts, shown in Figure 5, demonstrates that despite the extensive visualisation in terms of geometrical forms, designers need to explain and refine the semantics of these forms. For example, the horizontal circulation caused a major discussion (indicated by the relatively high frequency of related terms), when the idea of the vertical transportation came across fairly easily from the model (indicated by the relatively low frequency of the relevant keywords). During the session with the client the concept of a "floor" became a central issue (see Figure 5b), which changed the overall design concept. During the first session the interpretation of the design requirements illustrate that the concept of a "floor" was less important in comparison to the "circulation" issues (see Figure 5a). The higher values of word frequencies in the second session indicates again that the 3D presence within the design does not decrease the intensity and concentration of text-based communication when it comes to clarification of design ideas.




a. without client b. with client

Figure 5. Key concepts from the sessions

We expected that being within the design would assist to explain design ideas with less words, based on simple references to the objects. This is illustrated by the decrease of the average length of designer's utterances in the session 2 in comparison to the session 1, as shown in Figure 6a and b. The average[2] lengths of designers' utterances are less than a dozen words in the session 1 (see Figure 6a) and they go to less than half a dozen in the session 2 (see Figure 6b). More than a third of the words in an utterance goes to the class of stop words (words that are part of the grammatical form and do not carry semantic meaning). To some extent this supports our initial hypothesis, however, further investigation is required for more rigorous conclusions.




a. without client b. with client

Figure 6. Text statistics of the design session utterances.

[2] We used median as a central tendency estimator to avoid the biases of occasional very short and/or long utterances.

The relatively short length of utterances in sessions in “talking by typing” environments with 3D presence vs the "talking" in experiments 1 series can be explained also with some technological restrictions, connected with the display of avatar speech directly in the 3D scenery. In the case of a longer utterance, the text of the utterance can cover the avatar and the other participants could not see where the avatar is looking, pointing or the gestures that it performs during that moment, as illustrated in Figure 7.

We also considered the threads of conversation during the team meeting (based on the coding in "Communication modality" category and the references in the communication content). Despite relatively short phrases, the communication within the design was fairly focussed. As shown in Figure 7 the first half of the session is characterised by low level of local threads between individual designers. The substantial increase in the individual threads in the middle is an indicator of potential asynchronisation of the design session, correctly detected by the project coordinator. The work of the team had to be synchronised also, when the attention of the designers was divided between the model of the design concept in the virtual world and an external illustration of design concepts (utterances 115-120).

Table 1 shows the correlation between different communication categories in the session 1 (without the client). The results show high correlation between the design communication and communication for orientation category, which explains to some extent the observation that the 3D presence within the design does not decrease the intensity and concentration of text-based communication – a portion of the design communication "migrates" in the communication for orientation. On the other hand, there is no significant correlation between the communication related to technology and any other type of communication in the participatory session, which means that communication of technological issues does not have significant influence on the design communication in such environments.

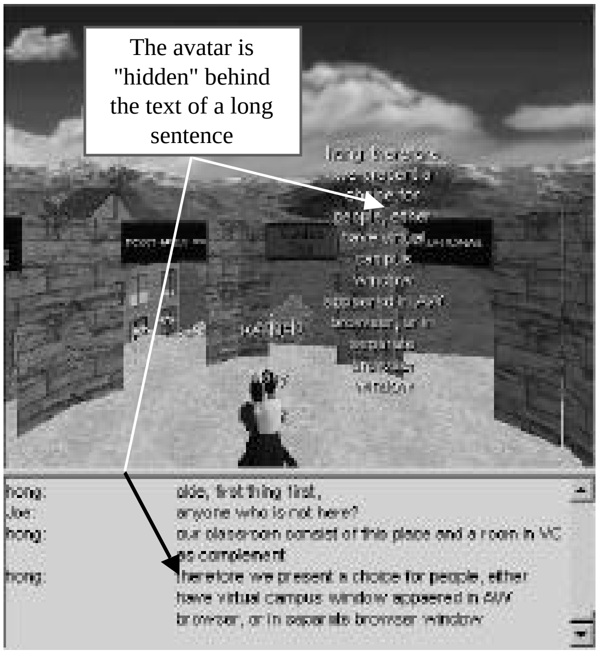



Figure 7. Short utterances are preferable in 3D environments with "talk by typing" communication

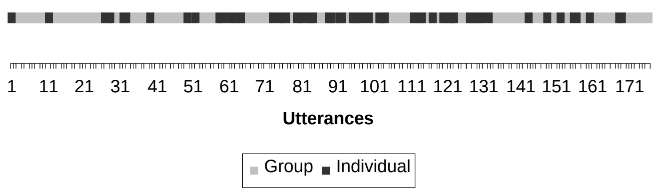



Figure 8. Changes in communication mode during the design session

Table 1. Correlation between categories

| | Communication control | Communication technology | Social communication | Communication for orientation | Design communication |
|---|---|---|---|---|---|
| Communication control | 1.00 | | | | |
| Communication technology | -0.31 | 1.00 | | | |
| Social communication | 0.60 | -0.22 | 1.00 | | |
| Communication for orientation | 0.65 | -0.16 | 0.77 | 1.00 | |
| Design communication | 0.78 | -0.24 | 0.64 | 0.93 | 1.00 |

## References


Forman, G. & Puffal, P. (Eds). (1988) . Constructivism in the computer age. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Fosnot, C. (1989). Inquiring teachers, inquiring learners: A con-structivist approach to teaching. New York: Teacher's College Press.

Goodman, Nelson. (1994). Of mind and other matters. Cambridge, MA: Harvard University Press.

Kolb, D. A. (1984). Experimental Learning, Prentice-Hall.

Lebow, D. (1993). Constructivist values for instructional systems design: Five principles toward a new mindset. Educational Technology Research and Development, 41(3), 4-16.

Maher, M.L. (1999). Designing the virtual campus as a virtual world, Computer Supported Collaborative Learning (CSCL99), pp 376-382.
Maher, M.L., Simoff, S., and Cicognani, A. (2000). Understanding Virtual Design Studios, Springer-Verlag, London.
Maher, M. L. and Simoff, S. (1999) Variations on a Virtual Design Studio in J-P. Barthes, Z. Lin and M. Ramos (eds) Proceedings of Fourth International Workshop on CSCW in Design, Universite de Technologie de Compiegne, pp.159-165..
Milligan, C. (1999) The role of VLEs in on-line delivery of staff development. JTAP Report 573. http://www.icbl.hw.ac.uk/jtap-573

Cicognani, A. and Maher, M.L. 1998. Two approaches to designing virtual worlds, Proceedings of Design Computing on the Net 98, *International Journal of Design Computing*, http://www.arch.usyd.edu.au/kcdc/journal Vol 1.

Damer, B. 1998. *Avatars*. Peachpit Press, an imprint of Addison Wesley Longman.

Greenberg, S. and Roseman, M. 1998. Using a room metaphor to ease transitions in groupware. *Research Report 98/611/02*, Department of Computer Science, University of Calgary, Calgary, Alberta, Canada.

Gabriel, G.C. (2000) *Computer-Mediated Communication in Design*, PhD Thesis, Faculty of Architecture, University of Sydney.

Gabriel, G. and Maher, M.L. 1999a. Does computer mediation affect design representation?, *Design Thinking '99*, Cambridge, MA.

Gabriel, G. and Maher, M.L. 1999b. Coding and modelling communication in architectural collaborative design, in O. Ataman and J Bermudez (eds) *ACADIA '99*, ACADIA, pp. 152-166.

Hong, K. (1999).

Lin, T-H. and Protzen, J-P. 1997. Desktop design: a toolkit approach to collaborative design, in M.L. Maher, J. Gero, and F. Sudweeks (editors) *Formal Aspects of Collaborative Design*, University of Sydney, pp 237-251.

Maher, M.L. (1999). Design and Representation of the Virtual Campus as a Place, *Proceedings of the 1999 Computer Supported Collaborative Learning Conference*, http://sll.stanford.edu/cscl99/paperindex.html, http://kn.cilt.org/cscl99/A47/A47.HTM

Maher, M.L., Simoff, S., Cicognani, A. 1999. *Understanding Virtual Design Studios*, Springer-Verlag, London.

Maher, M.L., Cicognani, A., and Simoff, S. 1997. An Experimental Study of Computer Mediated Collaborative Design, *International Journal of Design Computing* (http://www.arch.usyd.edu.au/kcdc/journal), Vol 1.

O'Connail, B. and Whittaker, S. (1997) In *Video-Mediated Communication*(Eds, Finn, K. E., Sellen, A. J. and Wilbur, S.) Lawrence Erlbaum, Mahwah, NJ, pp. 107-131.

Olson, J.S., Olson, G.M. and Meader, D. (1997) In *Video-Mediated Communication*(Eds, Finn, K. E., Sellen, A. J. and Wilbur, S.) Lawrence Erlbaum, Mahwah, NJ, pp. 157-173.

Simoff, S. J. and Maher, M. L. 2000. Analysing participation in collaborative design environments. *Design Studies*, **21**, 119-144.

Sudweeks, F. and Albritton, M. (1996) In *Proceedings of the 7th Australasian Conference of Information Systems (ACIS96)*, Vol. 2 (Eds, Keen, C. D., Urquhart, C. and Lamp, J.) Department of Computer Science, University of Tasmania, Hobart, Tasmania, pp. 701-712.

Woo, S., Lee, E. and Sasada, T. 1999. Shared virtual space for evaluation of design alternatives, in G. Jingwen and W. Zhaoji (editors) *CAADRIA'99*, Shanghai Scientific and Technological Literature Publishing House, Shanghai, pp89-95.

WebCT: http://www.webct.com/
TopClass: http://www.wbtsystems.com/
Lotus Learning Space: http://www.lotus.com/home.nsf/welcome/learnspace
Diversity University: http://www.du.org
Tappedin: http://www.tappedin.org
Virtual Campus: http://www.arch.usyd.edu.au:7888