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Communicating and Learning in "Virtual Seminars": The Uses of Spatial Metaphors in Interface Design

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Abstract: The use of computer conferences as "Virtual Seminars" has become a convenient way to allow spatially seperated participants to interact under the purpose of acquiring specific knowledge in the area of distance education. In order to facilitate orientation, to indicate social meanings, and to structure the communicative processes, two different types of spatial metaphors have been applied in interface design of these telematic settings: large-scale metaphors depicting extended geographical areas (campus-sites, buildings) and small-scale metaphors depicitng rooms. Their adequateness crucially depends on the correspondence between the real world domain and software domain. Possible obstacles for this match stem from a lack of providing interactivity, from cluttering the interface with pseudorealistic details and from the specifities of the asynchronous and text-based communication modes.

Key Words: Telematics, Computer Conferencing, Virtual Seminar, Interface Design, Metaphor

1 Introduction

Traditional forms of distance education are dominated by phases of isolated learning with text-based materials in combination with few face-to-face meetings. This type of distance education may widely lead to isolation amongst the learners, which can, however, be partly overcome by new forms of computer-based telecommunications, in particular computer conferences [Feldman 1986], [Bikson and Eveland 1990], [Phillips 1990]. They offer the participants the chance to come into contact with each other and with their tutors on a regular basis without the need for meetings - which are costly. Thus, the primary advantage of such conferences lies not so much in the unidirectional dissemination of learning materials, but in the elaboration of already acquired knowledge by means of intensive interaction with a group of peers and tutors [Davie 1989].

Compared to traditional forms of distance education, computer conferences allow a number of psychological aspects to be taken into closer consideration, and this in turn facilitates a deeper elaboration of already acquired knowledge [Harasim 1990], [Kaye 1992], [Collis 1993], [Hiltz and Turoff 1993]:

- Assignments and the evaluation thereof can be exchanged directly between learner and tutor (= vertical communication).
- Feedback concerning the actual state of the learning process can be given in a more contingent manner.
- Problems and questions arising during learning can be put forward by the learner and answered directly by the tutor.
- The horizontal communication between the learners is also facilitated. It includes various forms of collaborative learning as well as the exchange and discussion of information and the solution of problems.
- The task-oriented learning process can be enriched by social exchange and more informal communication.

These properties of computer conferences show strong parallels with real-world classroom teaching and real-world university seminars without the necessity of bringing the learners together spatially and temporally. In a broad sense, computer conferences can thus be seen as a kind of "virtual seminar", which encompasses a number of learning possibilities of real-world teaching in an asynchronous and dislocated manner [Hiltz 1992].

2 How to Set Up a "Virtual Seminar" by Computer Conferencing

A necessary precondition for its successful implementation is the careful planning and structuring of the computer conference. Empirical evidence shows that conferences need well-prepared conference moderators, a set of acknowledged communication rules, a number of learning-relevant goals, the guided application of knowledge-acquisition techniques and a software which provides tools to easily navigate and communicate and to process information.

Because of the existence of well-established structuring principles in real-world learning settings, a promising starting point would be to model the overall structure of a "virtual seminar" accordingly. For example, moderators could act in a manner which is similar to that of teachers in seminars, e.g. regulating the communication flow by steering questions and summaries and motivating students through positive feedback. Also, special parts of the conference could be devoted to the exchange of more informal messages, which function similarly to real-world "coffee breaks" and establish a feeling of social presence, togetherness and group identity. In summary, this concept of a "virtual seminar" has at least two major advantages: it allows the recurrence of already well established principles for the design of real-world learning

settings and it gives the possibility of constructing an integrated and coherent scenario of a computerized communication-based learning environment.

The aspect of coherence can be further exploited if its underlying structure is made explicit to the learners. This can be accomplished through the utilization of a visual metaphor in the design of the interface structure of the conference-software. In the area of traditional human-computer interface design, the use of real-world metaphors has a successful and long-standing tradition. Wellknown examples are the desktop metaphor of the Apple MacIntosh Interface or the calculating sheet metaphor of Visicalc or Excell. The idea behind these software programs is to provide the user with an interface that is structured according to a real-world domain with which he is familiar. Thus, already existing knowledge is activated which the user can transfer and readily apply to the new software.

From a cognitive science point of view, providing the user with an interface metaphor has a number of advantages [Carroll et al. 1988], [Hutchins et al. 1986]:

- it speeds up the learning process of software usage
- it allows the user to anticipate possible options of task accomplishment (e.g. the icon of an waste paper basket suggests the possibility of deletion)
- it allows the user to generate a functional mental model of the software which in turn leads to the generation of valid assumptions about the behaviour of that software
- it also allows the user to formulate hypotheses about possible causes of and repair mechanisms for errors

Additionally, for the field of computer-mediated communication, certain possible advantages of "classroom" and "campus" metaphors can be assumed:

- by visibly establishing a virtual classroom, a feeling of social presence und belonging to a specific group could be enhanced
- the participants could transfer and apply familiar communication rules and interaction patterns to the conference, leading to more regulated behaviours

Despite present technical problems, a growing number of conferencing software has been designed on the basis of graphically displayed real-world metaphors. Apart from the "traditional" desktop metaphor, of which FirstClass® is a typical example, the majority of these programs is based on a spatial metaphor including campus-like areas and classrooms. Typical examples are VMCO [Acker 1989], "Thought Box" [Alexander and Lincoln 1989] and [Alexander 1992], CyCo [Benford et al. 1993], EDUBA [Duenas 1995], or CO-LEARN [Derycke et al. 1995].

Comparable developments can also be found in the context of multi-purpose "habitats", which were originally developed as multi-player online virtual environments [Morningstar and Farmer 1990]. Meanwhile, they are extended to more

serious applications in the context of collaborative work or knowledge acquistion, in order to provide a "social virtual reality" which allows multiple participants to interact and communicate in pseudo-spatial surroundings [Curtis and Nichols 1993]. Examples are the "Virtual Academy" based on the ExploreNet software [Moshell and Hughes 1995], Diamond Parc [Rich et al. 1994] or "Cybercampus", based on the Interspace software. The underlying design philosophy of habitats is to enhance the immersiveness of the system through maximizing the realism of the virtual communication setting. A number of these systems are also providing advanced technologies of user control mechanisms (e.g. body position sensing technologies) and video and audio input-output facilities, thus giving the user a feeling of "telepresence" [Steuer 1992].

Thus, computer conferencing systems as well as habitats make use of spatial metaphors in its interface designs. They confront the user with a three-dimensional layout which is populated by (stable or animated) objects and persons, assuming that he can readily apply his real-world knowlegde about scenes and topological relations to understand the functionality of the software and to behave accordingly.

3 Types of Spatial Metaphors

The spatial metaphors that the mentioned software systems employ can be classified into two basic types, namely those depicting large-scale spatial areas and those showing small-scale areas.

The large-scale area metaphor utilizes the concept of a larger geographical site comprising of a number of distinguishable places with different functionalities. Examples are campus-sites (with different buildings, like lecture-halls, cafeterias, libraries) or large buildings (with different rooms, like entrance halls, seminar-rooms etc.). In the "real world", the topography of large-scale areas primarily serves the function of providing convenient transitions between the different locations of the site. Similar, the purpose of large-scale metaphors in interface design is to visualize the complex structure of computer conferences and to allow the user to easily switch between their different functional parts.

To achieve this, the spatial visualization has to fullfill two major requirements. First, it helps the user to generate a kind of "cognitive map", which facilitates orientation and navigation between the numerous modules or subunits of the computer conference. Thus, the visual specification of their topological relations allows the user to determine where he actually is, where the different places of the site (representing subunits of the conference) are located and how he can reach them. Based on the findings of psychological research on orientation in geographical settings, the interface should include equivalents of salient and easily recognizable "landmarks", and provide map-like overviews and introductory "guided tours" [Downs and Stea 1982], [Murray 1992].

Second, besides facilitating orientation, an equally important function of spatial metaphors could be to convey relevant "social meanings" through the location and visual appearence of the different places they depict [Csikszentmihalyi and Rochberg-Halton 1981], [Stokols and Shumaker 1981]. In a sense, characteristics of buildings or places form a culturally defined code, which indicates their importance, purpose, and accessibility and thus helps the participants to decide which of the places they should visit to accomplish their actual goals. For example, in real settings important places are typically located at the center of the site, occupy more space then less important places, and can be reached directly from almost everywhere. Additionally, through "architectural features" places or buildings often allow inferences about their purposes (cafeterias look different from libraries) and they can also indicate their accessibility (open doors or lit windows indicate accessibility, lowered shutters indicate inaccessibility).

To date, the majority of software products designed for telecommunicational purposes primarily exploits the orientational uses of large-scale spatial metaphors, whereas its function as carriers of social meaning has not yet been adressed in a systematic way. Similar, even if applying large-scale metaphors, only few interfaces make use of the second type of spatial metaphor, namely the visual depiction of small-scale spatial arrangements within specific locations. This "room"-metaphor rests on the assumption that real-world settings and interactions are spatially organized and therefore distances and arrangements of persons and objects provide orientational aids and convey social meanings.

Again, small-scale spatial metaphors can fullfill a number of different functions within the context of interface design. First, the vizualization of a room can be used to enumerate the stable characteristics of the setting, i.e. its purposes, the number of participants, and its available tools. Typically, this is accomplished through depicting each of the participants and tools as a distinguishable icon and by placing these icons simply in front of a "wallpaper" showing a pictorial depiction of the room.

Second, the room-metaphor can also be used to indicate the inherent social implications of the spatial arrangements. Normally, spatial relationships show a close correspondence to the social and personal relationships in groups. Certain roles and their associated behavioural norms are often "coded" via spatial positions in a room (e.g. the person at the head of the table holds the role of the chairman, who leads the dicussion) [Goffman 1967], [Wicker 1984]. Additionally, spatial proximity of persons and their spatial orientation towards each other often reveal detailed information about their personal relationships and their willingness to communicate [Hall 1959], [Argyle 1975]. Typical examples are round-table arrangements for discussion groups or one-speaker-many-listener configurations of seats in lecture-halls.

Finally, a further purpose of small-scale spatial metaphors is to provide a means for structuring communication processes, which is best exemplified by the work of

Benford [Benford et al. 1993]. In their model, each participant can be characterized by two space-related attributes: the focus of a person represents a subspace within which a person focusses his attention and the complementary nimbus determines the spatial area in which the person is noticable. In a given "virtual room" where a computer conference takes place, the interplay of nimbus and focus determines for each participant which of the other group members he is aware of, which contributions he notices, which of the other group members is aware of him and which of the others notices his contributions. Through virtually moving in this room, these aspects can be continously changed, resulting in different coalitions, subgroups and interaction patterns.

In sum, in its most elaborate version the small-scale spatial metaphor can be seen as an attempt to enhance the "social imageability" of the telematic setting, i.e. its "capacity to evoke vivid and collectively held social meanings among the occupants and users of a place" [Stokols and Shumaker 1981]. This enhanced social imageability can be expected to have two consequences. First, it should evoke a feeling of social presence and of belonging to the conference group [Short et al. 1977], [Spears and Lea 1992]. Second, as the work of Benford [Benford et al. 1993] shows, it can provide a convenient way to implicitly implement a number of communication rules without the necessity of stating them explicitly. From a psychological point of view, this could reduce the amount of cognitive load (fewer communication rules are to be remembered), lessen the feeling of being too constrained in communicative behaviour and also help to structure the conference according to prespecified norms.

4 Adequateness of Spatial Metaphors

Though the use of metaphors in the field of computer conferences has a number of potential benefits, possible shortcomings also have to be taken into account. They stem from the fact that the adequateness of a given metaphor for the functionality of a specific software program depends crucially on the exact correspondence between the real world domain and the software domain in terms of both its conceptual elements and their structural and functional interdependencies. Any discrepancies between source and target domain can lead to serious misconceptions and usage errors [Carroll et al. 1988], [Hutchins et al. 1986], [Nardi and Zarmer 1993]. Such discrepancies can be caused by three different sources, namely by a lack of interactivity, by a "wallpaper-realism" which clutters the display with nonfunctional and pseudorealistic details, and by the inherent structural discrepancies to real-world settings stemming from the specific modes of communication found within telematic settings.

First, in real-life settings visual appearances of persons and objects as well as their distance and orientation directly "afford" certain behavioral opportunities and restrict others, and they allow persons to act upon these affordances in a contingent way [Gibson 1979]. Thus, to prevent misconceptions of spatial metaphors in telematic

interfaces, these metaphors have to be coupled with a degree of interactivity that allows the users to behave in correspondence with the depicted visible features and topological relations. For example, if one of the participants of a telematic setting is actually using a specific tool (e.g. browsing a database), this person-tool relationship should be depicted accordingly, especially if it hinders both person or tool from other interactions.

Second, the notion of a "fit" between properties of real world domain and software domain implies that only those real world features should be depicted that have a direct structural or functional counterpart within the software. As [Derycke et al. 1995] have pointed out, cluttering the interface with irrelevant or nonfunctional visual details in order to achieve a greater sense of "realism" can confuse users and lead to errors and cognitive overload.

Finally, in the case of computer conferencing important differences to real-world learning settings result from a number of unique medial properties of computer-mediated communication [Harasim 1990]: In contrast to face-to-face communication, the members of computer conferences are spatially separated and interact in a text-based and asynchronous way. These attributes cause both new structures of interaction episodes and also drastically altered types of communicative behaviour.

For example, the enhanced temporal flexibility of asynchronous communication leads to a significant increase in the time that is required to complete a discussion topic [Levin et al. 1990]. To reduce the overall discussion time, most users therefore compose messages in which a number of topics are discussed simultaneously. This leads not only to altered message contents (e.g. a higher percentage of conditional statements), but also to a different communication structure with a lot of messages containing cross-references and "multiple threads", which has no parallel in face-to-face-communication [Black et al. 1983]. Thus, the applicability of the room metaphor for this type of asynchronous conferencing can be seriously questioned, because it implicitly assumes a single-topic communication structure. To stick to the metaphor, the introduction of a kind of "multiple personality" would be necessary, with the ability to be present simultaneously at different locations in the "virtual room", thus being able to consider and contribute to multiple topics all at the same time.

A related problem arises from the conjunction of asynchronity with written communication. To be asynchronously retrievable, the conference messages have to be stored. The accumulation of these messages leads to the availability of an elaborated text-based conference "history". Therefore, apart from the synchronous structure, consisting of the interrelations of the conference members, computer conferences show a second diachronical structure consisting of the temporal and conceptual relation between the conference messages, which is absent in face-to-face educational settings. This opens new possibilities of argument referencing, message browsing and information processing not available in traditional forms of real-world teaching [Mackay 1988], [Gissurardottir 1993]. At the same time, it offers the

possiblity of applying the spatial metaphor in a completely different way, namely to visualize the temporal structure of the conference in a hypertext-like form with messages as interlinked nodes [Nilan 1992].

5 Conclusion

In sum, the last examples show that the applicability of small-scale classroom metaphors can only be partial, because computer conferences differ from real-world educational settings in a number of attributes, the most important being in their asynchroneity, the spatial separation of the participants and their primarily text-based communication mode. This incompleteness of the match between real-world learning settings and the conference interface may produce a number of drawbacks. Most important, the conference members could erroneously restrict themselves to the functionality of the real-world settings without noticing the advanced possibilities and the altered necessities of this new medium (e.g. utilizing information processing capabilities). This could lead to a serious impairment of the efficiency and effectiveness of knowledge acquisition and elaboration via conferencing [Eastmond 1994]. On the other hand, as already mentioned, adequately selected metaphors could enhance the feeling of being present in a social (not technical) setting and facilitate processes of orientation and coordination between the learners.

Despite these uncertainties concerning the applicability of real-world metaphors in the field of computer conferencing, and despite the availability of a number of prototypes [Acker 1989], [Alexander and Lincoln 1989], [Alexander 1992], [Benford et al. 1993], [Derycke et al. 1995], [Duenas 1995], direct empirical comparisons of their presence and absence or of the applicability of different metaphors are virtually inexistent. One exception is a study conducted by [Ahern 1993]. In a comparison between a text-based and a hypertext-like graphic interface, he found that the users of the graphic interface spent more time at the terminal and exchanged more messages, but showed no differences in satisfaction scores and in course grades. As long as no other empirical investigations have been conducted, the generalizability of these findings remains an open question. Further, because of the utilization of a graphic interface with hypertext-like visualization, aspects of spatial metaphors were not considered during the study.

Due to the increasing power of networks and hardware and in line with advances in technologies aimed at "virtual realities", an intensified interest in graphic interfaces and the underlying metaphors must be expected. Therefore, an urgent need exists for theoretically and empirically analyzing the cognitive, motivational and social implications of the selection and application of real-world metaphors in the field of computer-mediated communication systems for learning purposes. The following questions mark a first starting point for this line of research:

- Which analogies to real-world educational settings do participants of computer conferences spontanously apply in the absence of an explicitly designed interface metaphor?
- Which functionalities do users associate with specific metaphors and which "breakdowns" occur in the use of the conferencing software due to their erroneously applying these functionalities to the conferencing software in a generalized way?
- What is the impact of real-world metaphors on the present use of new features of conferencing software?
- Which metaphors lead to greater satisfaction, to a greater sense of social presence, to better orientation, to a reduced cognitive load and/or to a substantial improvement in elaborating already acquired knowledge?

To empirically address these issues, a combination of laboratory and field-oriented research seems to be the most feasible procedure.

6 References

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