



AALBORG UNIVERSITY
DENMARK

Aalborg Universitet

Students Designing ICT Support for Collaborative Learning in Practice

Ryberg, Thomas; Ponti, Marisa

Published in:

Networked Learning Conference 2004 - conference proceedings

Publication date:

2004

Document Version

Publisher's PDF, also known as Version of record

[Link to publication from Aalborg University](#)

Citation for published version (APA):

Ryberg, T., & Ponti, M. (2004). Students Designing ICT Support for Collaborative Learning in Practice. In S. Banks, P. Goodyear, V. Hodgson, C. Jones, V. Lally, D. McConnell, & C. Steeples (Eds.), Networked Learning Conference 2004 - conference proceedings Lancaster University.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- ? Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- ? You may not further distribute the material or use it for any profit-making activity or commercial gain
- ? You may freely distribute the URL identifying the publication in the public portal ?

Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.

[NLC2004](#) / [Proceedings](#) / [Symposia](#) / [Symposium 13](#)

Rethinking Virtual Space as a *Place* for Sociability: Theory and Design Implications

Marisa Ponti and Thomas Ryberg

Göteborg University and Aalborg University

marisa.ponti@ped.gu.se, ryberg@hum.auc.dk

ABSTRACT

In this article, we offer theoretical reflections on the notion of place in which learners supposedly develop and evolve a structure of social interactions in networked learning environments. We claim that a general concern is to develop more social artefacts that may help learners organise the virtual place in a way that is meaningful to them and helps foster their social presence. Drawing from symbolic interactionism we examine the ways in which individuals interact with their environment, and from Activity theory, Wenger's communities of practice, and Wartofsky's taxonomy of artefacts to elaborate on the notion of social artefact.

Keywords

Activity theory, artefact, place, sociability, social interaction, virtual space

INTRODUCTION

One of the major beliefs of current thinking about learning is that learning is a social, cultural, and interpersonal process, which is driven as much by social and situational factors as by cognitive ones.

In this view, teaching and learning constitute a social process of communication that occurs in a social and cultural environment (e.g., the classroom or the workplace). The classroom is the place where a structure of social interactions develops and evolves and where a number of events happen and influence students' behaviour. In other words, the classroom is the "formative context" (Ciborra and Lanzara, 1994), where participants routinely engage in active creation and attribution of meanings. In other words, it is a place in which students and teacher make sense of who they are and what they are expected to do.

In this article, we argue that the great flexibility of virtual spaces, with their potential sense of transience and impermanence, plays a role in shaping the way routines and rituals are formed. This requires participants to engage in a

process of re-creation of meanings to cope with the involved uncertainties and not rely on a passive process of simple acknowledgment of the new place.

Thus far, designers of networked learning and computer-supported collaborative learning environments have paid most attention to technological capabilities and far less to the support of a social context. This lack of attention resembles the lack of research into the interface between education and design of educational facilities that Sommer (1969) lamented, being educators mainly concerned with student behaviour and designers with aspects of the physical environment.

This article intends to develop some theoretical reflections on the following questions:

- How does the social design of networked learning environments change the nature of sociability? Does it allow us to engage in meaningful relationships that help us define who we are and what we are doing?
- How can networked learning environments become a more social artefact?

Being a socially situated tool, software is not designed in a historically blank and culturally neutral way, but tends to embed the systems of meaning of its designers. We claim that a general concern is to develop ways to increase the probability that social interactions occur in a network-based learning environment and that a more social artefact may help learners organise the virtual space in a way that is meaningful to them and helps foster their social presence. We conduct an analysis drawing on symbolic interactionism to examine the ways in which individuals interact with their environment, and from Activity theory, Wenger's communities of practice, and Wartofsky's taxonomy of artefacts to elaborate on the notion of social artefact.

The active, constructive and materialistic nature of learning

In activity theory (AT) the relation between an individual and the object of activity is mediated by a variety of man made artefacts (Vygotsky, 1979). Drawing upon the works of Leont'ev (1978), it also becomes apparent that activities are fundamentally collective phenomena, which cannot be understood in solely individual terms. On the contrary, development of the human psychological functions and our interaction with the environment are seen as embedded in socio-historical collective and productive activities mediated by material artefacts.

A second important notion within the activity theoretical framework is that humans are not merely a product of a biological or societal development, but they are active constructors of their social and material environment. The productive activities in the social and material world simultaneously transform and change our psychological functions (Vygotsky, 1979).

In this sense, not only does the use of mediating artefacts concern how we act upon the world, but also how the artefacts that we produce "act back upon us".

AT emphasizes that learning is something taking place among the learners and not only in the individual head. Hence learning is seen to be facilitated through dialogue and collaboration, and the importance of externalisation and reification of mutual understandings, dialogues and reflections into shared external artefacts is clear in Engeström (1999, 2001).

Equivalence can be found in Wenger's theory of what constitutes meaning (Wenger, 1998). The negotiation of meaning is a twofold process of participation and reification: on the one hand, people interact with each other and engage in the community; on the other hand, they externalise and objectify their negotiated meaning. Through a community's interactions over time, the community establishes what Wenger calls a "shared repertoire". The shared repertoire includes

e.g. routines, rituals, tools, symbols and concepts:

“The repertoire combines both reificative and participative aspects. It includes the discourse by which members create meaningful statements about the world, as well as the styles by which they express their forms of membership and their identities as members.” (Wenger, 1998, p. 83).

Whereas Engeström primarily focuses on productive activities (e.g. the objects and outcomes of the activity), which are mediated by a community, Wenger focuses more on the ongoing participation, engagement and production of meaning within the social practice itself. From these two perspectives, we can identify two closely intertwined processes and artefactual differentiations: the products and sources of the learning process (models, concepts, documents, discussions), and the ongoing social construction of meaning and identity of the learning community. While the former is a more immediately observable level of the learning process, the latter is a more invisible level that, however, is crucial as it defines the meaning of the objects and outcomes of the learning community. Thus learners as a social entity simultaneously produce concrete artefacts and a community or social landscape, in which the meanings of these artefacts are negotiated. These processes underline the importance of supporting sociability within network-based learning environments.

Teaching and Learning as a Social Process of Communication

Activity theory and Wenger’s theory provide a point of departure for the analysis of teaching and learning processes, as these perspectives allow us to examine the dialectical relationship between learners, their role as producers, and their social environment.

Typically a classroom consists of a group of individuals who work together in a certain room space over a period of time. In this environment, from their first encounters, both teacher and students:

“join together to construct and conduct the events and activities and the routines and rituals that define their daily lives. As individuals they interact, they observe, monitor, and interpret the behaviours and actions of others ...” (Weade, 1992, p. 94).

Together, teacher and students develop and evolve a social structure that establishes social norms, permissible behaviours, interpersonal relationships, etc. In this context of social interaction, participants foster the learning process through social exchanges (such as give and receive feedback, guidance, encouragement, etc.) (Collins & Green, 1992). This social structure is the texture in which the “*structure and meaning of an evolving academic discourse is embedded*” (Weade, 1992, p. 95). In other words, the development of a social structure mediates the kind of interactions between participants: who can talk to whom, in what ways, for which purposes, under what conditions, and with what real or expected results.

The notion of place and its importance for sociability

Generally speaking, human activities take place in enclosed spaces that are supposedly designed to support them. Places are not just hollow containers, but spaces whose design and layout intertwines with the creation of social structures. A place plays an important role in “encoding the cultural and social understanding of the behaviour and actions appropriate to an environment” (Lee, Danis, Miller & Jung, 2001).

The classroom has been and still is the traditional place of teaching and learning. The classroom place – as well as the whole institutional setting in which the classroom is located – with its size, design, features, equipment, and physical gatherings influences the socialisation process. The classroom is the “formative context” where participants routinely

engage in active creation and attribution of meanings. It is a place in which students and teacher make sense of who they are and what they are expected to do, by sharing understanding of appropriate behaviours and interpretation of environmental cues.

Typically these physical elements are implicit and their influence on social behaviour is often taken for granted. However, when we work in a virtual space, the structure of social interactions that may support the learning and teaching process is most often “invisible” to the participants and the need arises to make it explicit (Dirckinck–Holmfeld & Sorensen, 1999). The great flexibility of virtual spaces, with their potential sense of transience and impermanence, arguably influences the way routines and rituals are formed. This requires participants to engage in a process of re–creation of meanings to cope with the involved uncertainties and not rely on a passive process of simple acknowledgment of the new place. In so doing, they become involved in a process of place–making, which is necessary in order to appreciate the online environment (Lee *et al.*, 2001) and, in turn, to develop conditions for sociability meant as the intensity and frequency of the need for social contacts.

Virtual Places: Designed for Socialising?

Sommer (1992) affirmed that interior classroom space has been taken for granted by both designers and users. He thought that designers were too concerned with the physical properties of the building, while teachers and students tended to adopt a fatalistic attitude and take the building as a given on which they had no control.

Oddly enough, the same neglect seems to happen with network–based learning environments.

So far many designers of network learning and computer–supported collaborative learning software have devoted much attention to various tools intended to support collaboration, cooperation and community–creation: email, bulletin boards, whiteboards, and shared task, just to mention a few. They have failed, however, to consider how to foster and sustain conditions that support a social context (Kreijns and Kirschner, 2001), despite the fact that in computer–mediated communication (CMC) failures tend to be more frequent at the social level than they are at the technical level (Gunawardena, 1995), and many empirical studies report disappointing results (Kreijns, Kirschner & Jochems, 2002).

Kreijns and Kirschner (2001) ascribed this lack of attention from designers to the common idea that social interaction will happen anyway, just because it is technologically possible. Besides, network–based CSCL software, albeit useful to some extent to support collaboration, is seriously limited by node to node connections that tend to support individual interactions, rather than multiple or connections within groups to create shared contexts on an ongoing basis (Mynatt, Adler, Ito, & O’Day, 1997). Another questionable assumption is that social interactions mediated by network technology follow the same patterns as those that occur face to face. In our view, this assumption dismisses that communication mediated by network technology is a different medium from physical proximity. In this medium, technology is not a passive tool but interacts actively with individuals, by affording them to do certain things, while constrains them in other ways.

Building on the idea from activity theory that tools reflect and affect what people think, we assume that a dialectical co–evolution of learner, electronic medium and learning and teaching situation should be put in place.

The implications for social interactions mediated by computers are in terms of understanding whether the design of the software to be used allow to define conditions which increase the likelihood that a social context is developed to trigger learning mechanisms and in turn generate cognitive effects.

Different levels of social artefacts

The notion of externalisation/reification plays an important part in the collaborative learning process, as externalised artefacts are both important facilitators for, and the outcome of, negotiations of meaning. The process of collaborative learning is facilitated by existing artefacts – but artefacts are also an outcome of the learning process through the learners' production of new shared artefacts, such as models, concepts, theories, the styles and discourses by which the members construct meaning, sense of belonging and identity. Artefacts can thus be seen as crystallizations of the produced knowledge and as parts of the shared repertoire of the members.

This view seems to imply that we should understand learners as very active producers of knowledge in a more concrete, materialistic sense. An important question in this vein becomes how we can design virtual learning environments that recognize the needs of learners to produce these various artefacts. This brings us to look more into the concept of artefacts. In this article we are especially concerned with what we coin as 'social artefacts' in relation to virtual learning environments. By 'social artefacts', we mean tools that play a part in constructing a sense of mutual accountability, belonging, negotiation of identity and roles between the learners. What functions as social artefact is always something to be analysed in practice, and therefore we will not propose a list of 'social artefacts'. Rather we will draw upon Wartofsky's and Engeström's notions of artefacts in order to propose different analytical levels of social artefacts, which might show useful in future analyses of virtual learning environments.

Wartofsky (1979) and Engeström (1987) identify three levels of artefacts: primary, secondary and tertiary artefacts.

"Primary artefacts are those directly used in this production; secondary artefacts are those used in the preservation and transmission of the acquired skills or modes of action or praxis by which this production is carried out" (Wartofsky, 1979, p. 202).

The tertiary artefacts are conceived of as objects of 'imaginative construction'. Though they are grounded in worldly practice, they are also freed from this and can serve as possibilities, visions, which can be thought of as a playground for restructuring of practices, identity and rules. Engeström (1987) further interprets the tertiary artefacts as ideologies or methodologies underlying an activity, and thus also as potential vehicle for development and change, as they are at the same time resources for creative and imaginative reorganisation of activities.

As for primary artefacts in virtual learning environments, we suggest these to be considered as concrete tools of production, or rather the possibilities for actions, whether this is initiation of a chat, videoconference, uploading a document, answering messages in a forum or playing a mini game.

How does the environment afford social interaction and learning activities (which encompasses both the availability and usability of various tools)? We suggest that secondary artefacts should concern the ability of the virtual environment to sustain, preserve and organize over time the communication and negotiation processes, the working routines and the ongoing social interaction of the learners, thus underlining mutual accountability and belonging. Also the secondary level should be considered as the environment's flexibility in enabling the learners to structure and reorganize the working processes, resources for learning and modes of social interaction. The preservation of dialogues, modes of practice and interaction simultaneously serve as a record for the learning and social processes. As practice is reified in the learning environment, it may become visible to the participants, and can thus serve as a springboard for creative reorganization of activities – as a tertiary artefact. For example the visibility of peoples' engagement in online dialogue can facilitate discussions on individual engagement or hidden power relations opening for dialogue on members' roles in the process. Furthermore, the tertiary aspect could be interpreted as the implicit rationale of the learning environment or the underlying pedagogical model of the system (Tolsby, Nyvang & Dirckink-Holmfeld, 2002). To what extent are certain routines and rationales already embedded in the design of the system? Some of these aspects will be analysed later on.

Making sense of where and who we are in the electronic medium

As said before, the social structure created by teacher and learners is the texture in which the “*structure and meaning of an evolving academic discourse is embedded*” (Weade, 1992, p. 95). Symbolic interactionism (Blumer, 1969) gives us a good theoretical basis to understand the structure of social interaction in the online medium:

- Individuals act on objects based on the meaning that the objects have for them. Blumer defined an object as “anything that can be indicated or referred to”. In a network learning environment, objects are social, such as individual peers, groups, teachers, etc., physical, such as computer hardware and software, and abstract, such as feelings individuals have about themselves, the others, and the online environment itself.
- Individuals create meaning of things by engaging in social interactions.
- Individuals change the meaning of things over time as interpretive processes occur.

In this perspective, the electronic medium does not shape human behaviour but contains *mechanisms* that people use to develop and change their systems of meaning. These cues embedded in the design of the software help/constrain the way in which individuals define who they are and what they are doing, similarly to some degree to the way physical buildings affect how occupants feel and think.

As much as our physical environment plays a significant role in the development of our identity and perception of others, electronic artefacts provide a structure of a potential organisation of social interactions. This structure includes elements like individuals, learning activities, communication system, distributed “spatial” arrangements, time arrangements, pedagogical models, and software design.

The idea of transaction between individuals and electronic artefacts borrowed from symbolic interactionism can help us think of social interactions as signs of complex environmental influences. Indeed, the relationships encompassed by the symbolic approach to electronic environment can help draw out some key features of the social systems that computers and networks claim to enable by understanding the way in which individuals perceive the capabilities of computers and networks as media of communicating and interacting, and the significance that the use of computers and networks has for them.

The Concept of Affordances for Sociability

In this article, we focus on the possibilities offered by the electronic artefact for meaningful social interaction. These possibilities are affordances (Gibson, 1979), which we intend here as mechanisms that can support socialisation needs and are enabled by the medium. Socialisation needs are human and hence media independent, but affordances are closely connected to specific media (Hollan and Stornetta, 1992).

As stated by Gaver (1996), affordances for sociability are properties of the environment that affect peoples’ interaction. They should not be simply perceivable, but factual and establish a clear relationship between action and interaction. Unfortunately, affordances for sociability in the electronic medium may not be perceived as easily as face-to-face.

Figure 1: Different affordances in the traditional classroom and the networked learning environment.

Students work together in the same room	Students can be geographically distributed
All are visible to and well aware of each other	They don't see each other
All have physical access to each other	Access to each other is not immediate and needs to be mediated
All can see when they can interrupt somebody	They need to discover who plays what role in the community
All can see when one person is with another one	Relationships are implicit, students need make them explicit through dialogue

It is clear that the traditional classroom is a more "socially translucent system" since it provides "perceptually-based social cues which afford awareness and accountability" (Erickson, Smith, Kellogg, Laff, Richards and Bradner, 1999). In this system it is easier for learners to engage in informal conversations, observe and imitate other's actions, exert peer pressure, and create, notice and conform to social norms. As Erickson et al. (1999) pointed out, this social translucency is a requirement for supporting communication and collaboration.

Unfortunately, we lose this social translucency in the virtual space. We are more socially blind in the electronic medium and the need arises for exploring ways of delivering socially salient information in the human computer interfaces. The task is challenging, however, as many important affordances for sociability in face to face are peripheral and unspoken, such as eye contact, body posture, the way we dress, etc. In addition to these mechanisms, a number of physical socialisation structures support "tacitly" the learning process and are also crucial, such as the buildings, the course plan, the schedule, the physical gatherings and so on (Dirckinck-Holmfeld and Sorensen, 1999).

All these elements deeply influence social behaviour but they are not easily captured by theories and thus embedded in design (Gaver, 1999.) Gaver also stated that simplistic social theories used in communication software design and malleability of technology contribute to support a vast range of behaviours, but make none obvious. This lack of general patterns does not help individuals anticipate expected or unwanted social behaviours, and may cause them a sense of loss of control that makes them insecure, as they often cannot use the knowledge of relation and navigation they are bodily familiar with in the real world (Sorensen, 1991). This sense of insecurity would not promote motivation to remain and engage in the learning experience.

Therefore we argue that this situation requires participants to engage in a process of re-creation of meanings to cope with the involved uncertainties and not rely on a passive process of simple acknowledgment of the new place.

THE ELECTRONIC MEDIUM AS A PLAYGROUND

In 2001, one of the authors participated in a project group (as a student), where the group created a virtual group room at www.igroups.dk (a free general purpose community service). The project was based on problem oriented project pedagogy (POPP) (Dirckinck-Holmfeld, 2002), lasted throughout a semester and was heavily mediated by the virtual group room, although the group met frequently face-to-face. Two central features of *Igroups* will be analyzed and discussed in this article: a mini-game and the file space.

The game, called "Bubblez", became an important social artefact for the group.

Figure 2: Two screen shots from "Bubblez".



Top 15 liste for Aalborg Universitet - projektgrup		
1.	Mikkel Dall	3876
2.	Mikkel Dall	3830
3.	Mikkel Dall	3376
4.	Mikkel Dall	3332
5.	Peter May	3238
6.	Mikkel Dall	3220
7.	Mikkel Dall	3090
8.	Thomas Ryberg	3010
9.	Peter May	2992
10.	Mikkel Dall	2900
11.	Mikkel Dall	2722
12.	Mikkel Dall	2714
13.	Peter May	2654
14.	Mikkel Dall	2652
15.	Mikkel Dall	2584

A friendly (but fierce) competition arose among the members who strived to make the highest score. The high-score list became a frequent topic of discussion both in the virtual forums and in face-to-face meetings, and the members engaged in writing fictional sports articles containing interviews with themselves, describing their own way to the top, and the reasons for the former champion's defeat; friendly chat sessions or e-mails were initiated solely to mock the others and point their attention to a newly attained 1st place.

As a primary artefact, a game is not productive in the sense as e.g. an axe; rather the product of a game is "fun" or "relaxation" for the individual player. However, the game also became a secondary artefact as the game entered the shared repertoire and initiated a discourse based on friendly competition that was sustained and constantly negotiated throughout the project. The game became a mode of belonging, participating and affirming membership in the virtual group. Although the game in a sense was counter-productive, considered that it took time away from writing the project, it was at the same time very productive in sustaining and constantly renewing a social practice. In part, the game also became a tertiary artefact for construction of imaginative and fictional 'articles', which functioned as a creative writer's playground far from ordinary academic language and discourse.

The file space was used to share documents so all members could download, edit and comment on each others work. An interesting aspect of the file space was the amount of time put into negotiations on how to use it. Over time the file space had to be re-furnished and re-organized as to meet changing demands in the work process. These re-organisations were collaborative efforts discussed in the forums and face-to-face meetings. The file space was an important part of coordinating the work process and also came to be a shared reference on the progress and structure of the project itself, as the organization of the file space was tightly interwoven with the temporal order and the conceptual interdependence of the individual chapters. The file space, however, was badly designed for some purposes as it solely sorted files and folders alphabetically/numerically, therefore the group had to put some effort into naming files and folders with initial numbers as to assimilate to and circumvent the systems functioning.

As a primary artefact the file space was a crucial tool to share, download and upload documents, but it also included a secondary level as it became the centre of negotiations on its own use and gradually came to be a representation of the project's progress. In this vein, it turned out to become a social artefact as the constant re-furnishing and regrouping of the files involved all members negotiating rules on how to name files and folders. One could say that the rationale built into the system forced the group to a creative re-organisation of practice, as the file sorting mechanism did not fit the group's need. However, it highlighted the need for the group to organize meaningfully the files in accordance with the progress of their project and their own negotiated rules, and not according to the technical rationale embedded in the system. We believe that the need of learners to structure their learning environment is not only necessary to the work process of the learners, but also is an important part of socialization, as the learners need to mutually attune and negotiate the use of the technological environment. This, in turn, is a crucial process in making sense of where and who we are in the electronic medium.

some reflections on implications for design

Our analysis leads us to suggest that it is difficult to speak of networked learning environments as realities that confront learners in the same way as physical educational environments do.

The notion of place is more problematic in the electronic medium: it is not given and self-evident as physical settings. It is not just “out there” for people to go and learn about it. The lack of predefined social systems of meanings in and the opaqueness of the electronic environment requires individuals to build their own personal and collective systems of meanings, which is the basis for the development of identity and social awareness. We create personal meanings of our reality by interacting with one another. What does this construction of personal meanings imply for network-based learning environments? In our opinion, it implies that designers should take into account this process of co-evolution encompassing learners, their role of sense makers and active producers of social reality, and the electronic place, when they develop their models of potential ecologies.

As earlier said, we do not mean to list a range of social artefacts; rather we mean to present some analytical concepts in order to point out that the production and use of a variety of artefacts is an intrinsic aspect of learning. These notions suggest that we should not think of learners as passive recipients or assimilators of the environment, but rather as very active constructors of artefacts and meaning, which, in turn, is a necessary part of the learning process. This way of thinking emphasizes that an important part of designing learning environments is to design for participation and engagement of the learners and enabling them to create their learning environment.

We believe that a virtual place must be constructed to large extent by those who are supposed to use it, and we question the idea of a fixed concept of user, on one side, and electronic medium, on the other side, since it excludes human explicit and implicit goals and does not take into account the needs of learners to re-structure and re-negotiate the learning environment. As Gaver (1991) stated, culture, experience, and intentions intermingle in the user-system interaction and this contributes to the definition and construction of “place”. The idea is not just simply adding features to the electronic medium, but to understand the individual and collaborative exploratory context, in which subjects and artefacts are coupled and not disjointed. We can argue that the intuitive approach to some extent comes from the perspective of the artefact as a playground, in which people engage in a range of relationships, and not only exchange information but also emotions.

REFERENCES

Blumer, H. (1969). *Symbolic interactionism: Perspectives and method*. Englewood Cliffs: NJ: Prentice Hall, Inc.

Ciborra, C., Lanzara, G., (1994). Formative Context and Information Technology: Understanding the Dynamics of Innovation in Organizations. *Accounting Management and Information Technology*, 4(2).

Collins, E., & Green, J. L. (1992). Learning in classroom settings: Making or breaking a culture. In H. H. Marshall (Ed.), *Redefining student learning: Roots of educational change* (pp. 59–85). Norwood, NJ: Ablex.

Dirckinck-Holmfeld, L. (2002). Designing virtual learning environments based on problem oriented project pedagogy. In Dirckinck-Holmfeld, L. & Fibiger, B. *Learning in virtual environments*, Samfundslitteratur Press.

Dirckinck-Holmfeld, L., & Sorensen, E. K. (1999). Distributed computer supported collaborative learning through shared practice and social participation. In C. Hoadley & J. Roschelle (Eds.), *Proceedings of the Computer Support for Collaborative Learning (CSCL) 1999 Conference* (pp. 12–15). Mahwah, NJ: Lawrence Erlbaum Associates.

Engeström, Y. (1987). *Learning by expanding*. Orienta-Konsultit Oy.

Engeström, Y. (1999). Activity theory and individual and social transformation. In Engeström, Y., Miettinen, R., Punamäki, L. (eds). *Perspectives on activity theory*. Cambridge: Cambridge University Press.

Engeström, Y. (2001). *The horizontal dimension of expansive learning*. Paper presented at the International Symposium 'New Challenges to Research on Learning', March 21–23, University of Helsinki, Finland, 2001.

Erickson, T., Smith, D. N., Kellogg, W. A., Laff, M., Richards, J. T., & Bradner, E. (1999). Socially translucent systems: Social proxies, persistent conversation, and the design of `Babble. In *Human Factors in Computing Systems: The Proceedings of CHI '99*: ACM Press.

Gaver, W. W. (1996). Affordances for interaction: The social is material for design. *Ecological Psychology*, 8(2), 111–129.

Gunawardena, C. N. (1995). Social presence theory and implications for interaction and collaborative learning in computer conferences. *International Journal of Educational Telecommunications*, 1(2/3), 147–166.

Hollan, J., & Stornetta, S. (1992). Beyond being there. In *Proceedings of ACM Conference on Human Factors in Computing Systems (CHI'92)* (pp. 119–125). Monterey, CA: ACM Press.

Kreijns, K., & Kirschner, P. A. (2001, October 10–13, 2001). *The social affordances of computer-supported collaborative learning environments*. Paper presented at the Frontiers in Education: The Future–Impact on Engineering and Science Education, Reno, Nevada.

Kreijns, K., Kirschner, P. A., & Jochems, W. (2002). The sociability of computer-supported collaborative learning environments. *Educational Technology & Society*, 5(1).

Lee, A., Danis, C., Miller, T., & Jung, Y. (2001). Fostering social interaction in online spaces. In M. Hirose (Ed.), *Human-Computer Interaction (INTERACT'01) – Eighth IFIP TC.13 Conference on Human-Computer Interaction* (pp. 59–66): IOS Press.

Mynatt, E. D., Adler, A. A., Ito, M., & O'Day, V. (1997). Design for network communities. In S. Pemberton (Ed.), *Human Factors in Computing Systems: CHI 97 Conference Proceedings* (pp. 210–217). Atlanta: GA: ACM.

Sommer, R. (1969). *Personal space: The behavioral basis of design*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Sorensen, E. K. (1991). Metaphors and the design of the human interface. In Kaye, A. R. (Ed.) *Collaborative Learning through Computer Conferencing: The Najaden papers* (pp. 189–199). Springer-Verlag, The NATO ASI series, Heidelberg.

Tolsby, H., Nyvang, T. & Dirckinck-Holmfeld, L. (2002). A survey of technologies supporting virtual project based learning. In *Proceedings of the Third International Conference on Networked Learning 2002* (pp. 572–580), Lancaster University and Sheffield University.

Vygotsky, L. S. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.

Wartofsky, M. 1979. *Models: Representation and scientific understanding*. Dordrecht: Reidel.

Weade, G. (1992). Locating learning in the times and spaces of teaching. In H. H. Marshall (Ed.), *Redefining student learning: Roots of educational change* (pp. 87–118). Norwood, NJ: Ablex.

[Top](#)