Supporting Social Awareness: Requirements for Educational CVE

Ekaterina Prasolova-Forland, M.Sc (contact author)
Institutt for datateknikk og informasjonsvitenskap, NTNU
Sem Sælands vei 7-9
N-7491 Trondheim
Norway
ekaterip@idi.ntnu.no
Phone: +4773593437
Fax: +4773594466

Professor Monica Divitini, PhD
Institutt for datateknikk og informasjonsvitenskap, NTNU
Sem Sælands vei 7-9
N-7491 Trondheim
Norway
monica@idi.ntnu.no
Phone: +4773594462
Fax: +4773594466

Abstract

Social awareness is essential for effective learning. However, natural environments do not always provide optimal support for it. We analyze the potentials of Collaborative Virtual Environments (CVE) in this context and provide a set of requirements for educational CVEs based on the needs of learning communities. We also present a prototype based on these requirements.

Supporting Social Awareness: Requirements for Educational CVE

Ekaterina Prasolova-Førland, Monica Divitini
IDI, Norwegian University of Science and Technology
E-mail: (ekaterip,monica)@idi.ntnu.no

Abstract

Social awareness is essential for effective learning. However, natural environments do not always provide optimal support for it. We analyze the potentials of Collaborative Virtual Environments (CVE) in this context and provide a set of requirements for educational CVEs based on the needs of learning communities. We also present a prototype based on these requirements.

1. Introduction

The notion of community in education has not been fully exploited. However, communities are a reality within any learning context. Students share knowledge not only with the persons in the same class or group. They rather rely on a complex network of communities spontaneously emerging within any educational context, being these communities of interest or communities of practice.

Communities are social aggregates that are fluid and emergent [23]. It is therefore difficult for community members to get an overview of the existing social structures. This is a problem because awareness of e.g. experience distribution and community membership creates occasions for knowledge sharing. Lack of this awareness creates continuous breakdowns in the flow of knowledge and it impacts negatively on learning. Hereafter we use the term social awareness to indicate awareness of the social situation in a group or community in a shared environment, which can be physical, virtual or both. This awareness includes knowledge on learners' roles, activities, positions, status, responsibilities, social connections and group processes.

There are various mechanisms for promoting social awareness in everyday life, like chance encounters, message boards, verbal and non-verbal cues [11]. These techniques are not always sufficient due to, e.g., physical distances between the students; different schedules for the group members; social fears and inhibitions; available spaces that are not optimal for meeting, working and information sharing. Various groupware tools have been used to promote awareness, overcoming the limitations of everyday modalities of interactions [9]. However, they mainly focus on supporting already established groups rather than fluid communities [17].

In this paper we discuss the possibility to use Collaborative Virtual Environments (CVEs) for creating an infrastructure to increase social awareness in communities of learners. In order to make this possible, CVEs must be designed taking into account the social nature of learning. Socio-cultural theories have lately been proposed as a theoretical framework for the design of CSCL systems because they emphasize the social nature of work and learning, see e.g. [6, 8, 16] . Among these theories we refer to the activity theory, based on the work by Vygotski [22], Leont'ev [13] and later Engestrom [5], and on the work on communities of practice by Wenger [23]. We adopt this perspective on learning for deriving a set of requirements for CVEs supporting social awareness in learning communities.

Next section discusses the notion of community and group. Section 3 introduces a characterization of CVEs that is used to present related work and to structure the presentation of the requirements introduced in Section 4. Section 5 briefly describes a prototype addressing these requirements developed using Active Worlds [1].

2. Communities and Groups

Activity theory is based on the idea that culturally defined tools mediate all activity, so learning is participation in cultural practice. Individuals and groups can be seen as "subjects" situated in *communities* mediated by rules of participation and division of labor. In order to better understand the notion of community we refer to the seminal work on communities of practice presented by Wenger [23]. In this perspective, "communities of practice can be thought of as shared histories of learning" [23]. Each activity is situated on a learning trajectory, so that students move through activities, progressing from partial to full participants, able to more flexibly use the cultural tools [8, 23]. Continuous negotiation of meaning is the core of social learning and involves two processes: participation and reification, together forming a shared repertoire. Participation is the "complex process that combines doing, talking, thinking, feeling, and belonging." [23]. Reification is the "process of giving form to our experience by producing objects that congeal this experience into thingness" [23]. The collection of such artifacts comprises the shared repertoire and history of the community, which is used by the subjects of the community in further activities and to support their movement along the learning trajectory.

Another concept key to social learning is identity. Wenger [23] argues that learning should be primarily addressed in terms of identities and modes of belonging, rather than skills and information. In this perspective, experiences involving new forms of membership and ownership of meaning are at least as important as the curriculum coverage. A learning community can strengthen identity by incorporating its members' past into its history and opening new trajectories. Identity is connected to the activities on the learning trajectory as well as to the roles students play. Another aspect of identity is multiple memberships, which involves reconciliation of boundaries and creation of bridges across the landscape of practice. In some cases, the boundaries are reified with explicit markers of membership, for example, titles and degrees. Participation and reification can create continuities across boundaries. For example, an artifact can be present in different communities; at the same time, people can participate in different communities at once.

Within communities, members can join in tighter interactions, forming groups. As for members of communities, members of the groups go through different trajectories of participation.

We can now reformulate our definition of social awareness: social awareness is awareness of the configurations and developments of learning trajectories and the patterns and histories of participations of the learners in the communities and groups.

3. Characterization of CVEs

CVEs are generally characterized according to the used technology, for example immersive vs. non-immersive, or number of dimensions (2D vs. 3D). Here we suggest a characterization of CVEs inspired by activity theory. In educational CVEs we consider activities performed by *learners* who belong to various groups and communities. Activities are mediated by *artifacts*. Learners and artifacts are contained in *space*. Space is a key resource for establishing and enabling an activity [2, 7], allowing different modes of participation and negotiation of common resources. Therefore, we propose a characterization of educational CVEs along the dimensions: *learner*, *place*, and *artifacts*.

3.1. The Learner

The learner is the user of the system. Elaborating on the classification proposed by Dickey [4] for users, we identify the following main elements for constructing learners: presence, embodiment and identity.

Presence is the extent to which user feels as if he is in the virtual world and to which other users and the environment appear to react to and be aware of the user [10]. The basic sense of presence in most virtual environments is supported by providing feedback to user's actions, a list of persons online (textually) and a group of avatars (visually) with their mutual orientation and position to each other. The users can then perform a number of actions on other users such as chatting and positioning avatars relative to the others.

User embodiment is concerned with the provision of users with a representation to make others and themselves aware of their presence in a virtual space [15]. Embodiment can be supported in different ways: choice of avatars, emotional expressiveness, and navigational and observational possibilities [4]. Avatars represent the identity of users, their status and their accessibility [19]. An important part of human communication in the physical world is body language like gestures and body postures, facial expression, direction of gaze [19], as well as clothes and make-up. Most CVEs support these features only to a limited degree. Some of the CVEs, like Active Worlds, offer a number of predefined gestures like WAVE and DANCE. The body language can also be generated by extracting key words from the text messages, for example, LOL and Kiss [19]. In most virtual worlds users can move the avatar by pressing the arrow buttons on the keyboard or the mouse. Special functions, like "rotate", "fly" and "teleport" are often available. In many systems, it is possible to observe the world from the 3rd person perspective, as well as from various altitudes or different perspectives.

Identity is often tied to a user nick, avatar or a unique user number. The identity is often associated with a reputation, a circle of acquaintances, a place in the social hierarchy in the virtual world [12]. The identity is often not constant [21]. In some systems, for example Active Worlds, identity is tightly coupled to the objects the user creates. The studies of early text-based MUDs and MOOs, e.g. [3], show the importance of communication in the identity construction in virtual environments. Another way of identity construction is the manipulation of shared artifacts [20] and co-construction of environment [21].

3.2. The Place

Places can be classified considering their outlook, structure, and function [18]. By the *outlook* of a virtual environment we refer to how it "looks like". The design could be quite abstract or on the contrary, seek to recreate a certain place as closely as possible. Typical examples of the latter category are the many universities and schools that introduced virtual representations of themselves (eCollege, VHS, Flo, Virtual Campus, etc.). For example, the design of Virtual Campus of the University of Sydney is based on the campus metaphor [14]. By the *structure* we understand the mutual relations between different parts of the virtual environment, for example the mutual position of rooms within a virtual campus or the spatial organization of buildings in a 3D world. The structure can be predefined or created and modified by the users. For example, the students using the LambdaMOO environment of the Virtual Campus [14] can add their own rooms to the global system of campus. On the other hand, chat worlds, like Palace and Bluxxun Interactive, offer little space for user modification. Finally, CVEs can play a number of *roles*, such as a meeting and working place, an information space for accessing and sharing information, an environment for simulations and demonstration of scientific concepts and art, and an arena for role-playing and story-telling. A system with a given design and structure can have one major role or several overlapping, interleaving roles, intended by the designer or introduced by the user.

3.3. The Artifacts

Artifacts can be e.g. whiteboards, 3D models of human body, documents, and virtual furniture. We define artifacts as units created and modified by users for the purpose of communication facilitation and task accomplishing. We can differentiate between pre-designed artifacts for common use, such as whiteboards and bulletin boards, and those created by individual users or groups, such as documents and graphical objects.

When artifacts are shared, they become both the subject and the medium for communication [20]. An artifact serves the communicational purposes by providing information about the actions performed on it and the identity of the person performing the actions. For example, the users can observe the modification of the artifact directly, either in real time (animation of other users' actions on artifact, pointers with the name of the modifier, highlighting etc) or post factum, by reflecting on the change in the parameters (position, color etc). The information about the performer of an action can be provided directly by observing avatars or other representations of users performing actions on objects or leaving records on the artifact with the information on who changed it and when.

4. Requirements for Educational CVEs for Supporting Social Awareness

Based on the understanding of learning communities presented in Section 2, we present a list of requirements for supporting social awareness. The requirements are organized along the three dimensions identified for the characterization of CVEs. When considering learners, CVEs must fulfil the following requirements:

L1: The representation of each individual learner must evolve with and reflect the movements of the learner along the learning and participation trajectories as well as the learner identity, for example, the activities, the roles and the multiple memberships of the learner in the groups and communities.

L2: The construction of identity should be supported by providing necessary communication channels and artifact manipulation. Communicational methods should facilitate the recognition of the communicational patterns among learners.

L3: The embodiment of a learner must reflect her place on the learning trajectory, i.e. the level of knowledge and skills, to support the distinction of "apprentice and master" and facilitate the "division of labor". The environment should offer the possibilities to easily navigate to other group/community members to keep social contact. The embodiment should permit emotional expressiveness to allow effective communication and also provide awareness about the actions and activities performed by others.

L4: In order to facilitate participation, the environment should make the learners aware of other learners, and the relationships between them, i.e. provide a sense of social presence.

When considering the place, CVEs must fulfill the following requirements:

P1: The place should provide a framework for the activities performed there and be structured, possibly hierarchically, to reflect the division of labor and resources, the structure of communities, the subjects and mutual relationships between them.

P2: The structure must be dynamic, to reflect and facilitate the changing structure of the communities and groups involved, the patterns of participation and the development of the learning trajectories, i.e. to the connection between the individual learner and the other learners, the memberships, responsibilities and resource division, interpersonal relationships, power issues and communication structure. At the meta-level, it must be possible to establish connection between individual learners into constellations of learners, reflecting either groups or communities, and between constellations of learners and places.

P3: The outlook can be static, but it must reflect the spirit and identity of the communities and groups.

P4: The environment should support a flexible usage of different parts of the place for playing different roles, for example places for meetings or information access. It should provide predefined tools for different roles and allow the learners to modify the place according to their current needs.

When considering artifacts, CVEs must fulfill the following requirements:

A1: The artifacts represent the cultural tools from the activity theory, facilitating the mediating communication, learning and task completion. Artifacts should together comprise a shared repertoire for the community.

Different types of artifacts must be allowed with related actions, to provide general environmental presence and to provide the awareness on the ongoing activities.

A2: It must be possible to associate artifacts to people, to provide the awareness of their participation and learning trajectories, i.e. activities, roles, responsibilities, resource division and memberships.

A3: It must be possible to leave traces of users action on the artifacts, reflecting the activities and resource ownerships

5. Prototype

To investigate the feasibility of the requirements, we developed a virtual world, Viras, using the Active Worlds [1]. Viras is based on the metaphor of *archipelago*, with islands connected to other islands via teleportation links, bridges, and roads (Figure 1). Islands are populated by users and various types of artifacts. We decided to adopt this metaphor after analyzing various spatial metaphors used in educational CVEs [18], trying to combine different features in order to achieve a high degree of flexibility. In Viras, users are represented by avatars, objects they create and the history of communications (L1). Users can communicate by text chat, messages sent to others or left in the world, changing artifacts, changing position of the avatar and making gestures (L2). The user can choose from a predefined list of avatars. The dynamic construction of user's identity is mostly achieved by the conversations and the created artifacts and constructions. Users may leave their traces everywhere, not only where they "live", but also in places belonging to groups or communities they are participating in or just visiting for a short time (L1). The communicational patterns are indicated implicitly by grouping of avatars and constructions and explicitly by the links and references left by the users in their areas (L2). The user can navigate through the environment by walking, flying, or by following teleportation links to islands belonging to other users, groups and communities. The effectiveness of this navigation depends on the amount and structure of links created by the users. The expression power of the embodiment is limited by the amount and selection of available avatars, so the level of knowledge is more likely to be expressed by the conversations and created artifacts. Avatars have a limited numbers of gestures, which may provide some information about the user's emotional status, but chat is much more effective. The awareness of the activities provided by the embodiment is mostly mediated through the position and movements of the avatar (L3).

By observing the in-built list of users online, as well as avatars present, their position and mutual orientation, the user can acquire a sense of social presence (L4).

The outlook of Viras is chosen to be an archipelago in order to support an informal atmosphere (P3). Moreover, an island defines clear territorial boundaries, but without the closeness of e.g. rooms and buildings. Also, islands connected to form an archipelago can serve as metaphor of the way communities and groups can be combined (P1). The environment can be used both for socializing and for work (P4). The outlook is partly static, since the design of the backdrop and ground are chosen by the administrator, as well as some constructions that to a certain degree influence the style and direction for user-made constructions (P3). The structure is, however, fully dynamic, since users can freely modify all constructions that are public or their own property, such as rooms, houses, islands, bridges, and roads. A number of house and islands templates are provided so the users can fill in their parameters, modify them, copy and create new ones. Users may migrate between different islands, settle together with friends or working partners, or can own several rooms or buildings distributed on the islands (P2).

The structure of the world is partly hierarchical and is meant to reflect the social structures within the group and communities, relations between them and between the individual members; for example, each person lives in a building or a part of it; each group owns an island or a group of islands. A community is represented by an archipelago. All islands and buildings are hierarchically connected by virtual bridges, or teleportation links, while some near islands are connected by real bridges visible on the surface and houses are connected by roads (P1). Each major island contains a meeting house for the whole group that resides there, which can also be transformed for other purposes. The main island in the center of the world provide users with a common meeting place and a major transportation node, as well with a collection of artifacts necessary for working and socializing (P4).

The requirements related to the artifacts demand a variety of artifacts for different purposes, as well as the possibility to leave the traces of the user's personality and activities on them. A number of such artifacts are provided so the users can fill in their parameters, copy and create new ones. There are artifacts for facilitating communication and transportation, such as templates for message boards, document links, teleportation links. There are also templates for artifacts facilitating personal expression, containing pictures, text and examples of buildings (A1). The users can leave their traces by creating and changing their own artifacts with a name and time stamp on it, copying public artifacts and thus making them their own or by destroying public property in their area (A2). The users also may leave explicit information about themselves and their activities in the description fields of the artifacts or by attaching signs with comments to them (A2, A3).

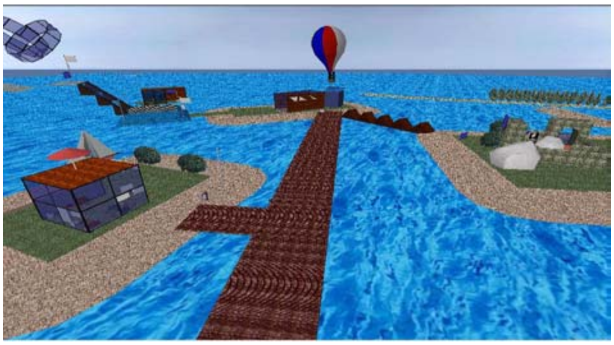

Figure 1. Archipelago

6. Conclusions

Based on a social approach to learning, we presented requirements that CVEs must fulfill and we have briefly described a prototype addressing these requirements. The development has been directed to the realization of a dynamic environment that can be shaped directly by community members. The focus in this initial phase has not been on providing a direct support for learning activities, but rather on providing a virtual space where these activities can take place. To test our approach, we performed a case study where about 50 students divided in 15 groups used the virtual world for a month. The increase in awareness was moderate, but many students suggested that it could improve if they could spend more time using the system and if the system would allow easier building and better overview. After our experience with the design of Viras and its initial usage, we are fully aware that the realization of all the requirements in one virtual world is complex due to the limitations of the technology and the different scenarios of possible usage, imposing different demands on the system. However, we believe that Viras is a good starting point for exploring more in details social awareness support by the means of CVEs. In this perspective, we are currently studying the usage of Viras by a new community of students to understand its impact on learning.

7. References

1. ActiveWorlds. www.activeworlds.com.
2. Benford, S., Bowers, J., Fahlen, L.E. and Greenhalgh, C., Managing Mutual Awareness in Collaborative Virtual Environments. in VRST, (1994), ACM Press.
3. Bruckman, A. MOOSE Crossing: Construction, Community, and Learning in A Networked Virtual World for Kids, MIT, Boston, MA, 1997.
4. Dickey, M.D. 3D Virtual Worlds and Learning: An Analysis of the Impact of Design Affordances and Limitations in Active Worlds, Blaxxun Interactive, and Onlive! Traveler; and a Study of the Implementation of Active Worlds for Formal and Informal Education, The Ohio State University, 1999.
5. Engestrom, Y. Learning by Expanding: An Activity-Theoretical Approach to Developmental Research. Orienta-Konsultit, Helsinki, 1987.
6. Fjuk, A., Sorensen, E.K. and Wasson, B., Incorporating Collaborative Learning, Networked computers and organizational issues into theoretical frameworks. in ICDE 99, (1999).
7. Giddens, A. The constitution of society outline of the theory of structuration. Polity Press, Cambridge, 1984.
8. Gifford, B.R. and Enyedy, N.D., Activity Centered Design: Towards a Theoretical Framework for CSCL. in CSCL1999, (Palo Alto, CA, 1999), 189-196.
9. Gutwin, C., Greenberg, S. and Roseman, M., Workspace Awareness in Real-Time Distributed Groupware: Framework, Widgets, and Evaluation. in HCI'96, (London, UK, 1996), Springer-Verlag, 281-298.
10. Hindmarsh, J., Fraser, M., Heath, C., Benford, S. and Greenhalg, C., Fragmented Interaction: Establishing mutual orientation in virtual environments. in CSCW98, (Seattle, Wa, 1998), ACM Press, 217-226.
11. Huxor, A. The Role of the Personal in Social Workspaces: Reflection on Working in AlphaWorld. in Churchill, E., Snowdon, D. and Munro, A. eds. Collaborative Virtual Environments, Springer-Verlag, 2001, 282-296.
12. Jakobsson, M. Rest in Peace, Bill the Bot: Death and Life in Virtual Worlds. in Schroeder, R. ed. The Social Life of Avatars. Presence and interaction in shared virtual environments, Springer-Verlag, London, UK, 2002.
13. Leont'ev, A.N. The problem of activity in psychology. in Wertsch, J.V. ed. The concept of activity in Soviet psychology, M.E. Sharpe Inc., Armonk, NY, 1981, 37-71.
14. Maher, M., Designing the Virtual Campus as a Virtual World. in CSCL1999, (Palo Alto, CA, 1999).
15. Mania, K. and Chalmers, A., A Classification for User Embodiment in Collaborative Virtual Environments. in Conference on Virtual Systems and Multimedia, (1999).
16. Miao, Y., Fleschutz, J.M. and Zentel, P., Enriching Learning Contexts to Support Communities of Practice. in CSCL1999, (Palo Alto, CA, 1999).
17. Prasolova-Førland, E., Supporting awareness in education: overview and mechanisms. in ICEE 2002, (2002).
18. Prasolova-Førland, E. and Divitini, M., Supporting learning communities with collaborative virtual environments: Different spatial metaphors. in ICALT2002, (Kazan, Russia, 2002), IEEE Press.
19. Salem, B. and Earle, N., Designing a Non-Verbal Language for Expressive Avatars. in CVE 2000, (San Francisco, CA, 2000), ACM Press, 93 - 101.
20. Snowdown, D., Churchill, E.F. and Munro, A.J. Collaborative Virtual Environments: Digital Spaces and Places for CSCW: An Introduction. in Churchill, E.F., Snowdown, D. and Munro, A.J. eds. Collaborative Virtual Environments, Springer-Verlag, 2001, 3-17.
21. Talamo, A. and Ligorio, M.B., Identity in the Cyberspace: The Social Construction of Identity Through On-Line Virtual Interactions. in First Dialogical Self Conference, (2000).
22. Vygotskij, L.S. Mind and Society. Harvard University Press, Cambridge, MA, 1978.
23. Wenger, E. Communities of Practice: Learning, Meaning, and Identity. Cambridge University Press, 1999.