

Supporting learning communities with collaborative virtual environments: Different spatial metaphors

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Abstract

In this paper we discuss the usage of Collaborative Virtual Environments (CVE) in educational settings. In particular we discuss the role that these systems can play in supporting learning communities. The focus of the paper is on the representation of space that underlies these systems. We present and compare different spatial metaphors presented in the literature and analyze how they support the needs of the learning communities.

1. Introduction

A Collaborative Virtual Environment (CVE) is a computer-based, distributed, virtual space where people can meet and interact with others, with agents or with virtual objects [24]. CVEs have been widely used in educational settings of different types, ranging from K-12 to higher education. Mainly, they have been adopted for their potentiality of offering a new space for promoting socialization.

The first CVEs were text based and were strongly inspired by adventure games, as it is evident in the first examples of MUDs (Multi-User Dungeon) and MOOs (MUD, Object Oriented). According to [21], MOOs allow for greater collaboration among students within and across classrooms. Bruckman [2] also points out that the presence of collaborators offered by these CVEs plays a key role in augmenting student motivations and in improving the learning process. In addition to the facilities offered by textual CVEs, graphical CVEs, either 2 or 3D, offer a richer collaborative arena for social encounters and community building [18].

Many authors have pointed out the importance of the space available to a community as a key resource for establishing and enabling an activity [9]. The existence of an environment where learners can have and share experiences is also acknowledged as one of the main requirements for learning [16]. As stated in [6], “the practices people develop are crucially dependent on where they take place”. In this paper we therefore want to

analyze the different spatial metaphors that underlie CVEs and see how they relate to the needs of learning communities.

The paper is organized as follows. Next section describes the different roles that CVEs can play in supporting learning communities. Section 3 presents an overview of different metaphors proposed in the literature, their comparison and analysis. Finally, Section 4 concludes the paper.

2. Supporting learning communities

The notion of community in education has often been underestimated. However, communities are a reality within any learning context and provide an invaluable support to learning. Students share and create knowledge not only with the persons that take the same class or that work on the same group. They rather rely on a complex network of communities that spontaneously emerge within any educational context, e.g. various communities of interest or communities of practice [26]. CVEs can be used to support communities in educational settings in many ways, as discussed in the following.

2.1. Supporting community building

Communities are social aggregates that are fluid and emergent [26]. It is often difficult for community members to get an overview of the existing social structures. This is a problem because awareness on e.g., community membership, role distribution, available resources, and ongoing processes is essential for collaboration and learning. CVEs can support learning communities by increasing the awareness of the current social situation and the underlying social structures in general. This can be done, e.g., by providing awareness through graphical clues about different social aspects, such as membership status.

2.2. Supporting communication

Communication plays a key role in keeping a

community alive. Particularly important is the communication that is triggered by casual encounters. This communication is reported to be essential for knowledge sharing [5] and strengthening the ties among community members. This communication is dependent on spatial arrangement, e.g. proximity of desks in a laboratory and attendance to the same classroom. A student that is not physically present in the “territory” of the community cannot take part in this communication. CVEs can help in overcoming this limitation since they allow communication independently by geographic location. Moreover, graphical clues can be used to indicate if someone is busy or is available for conversations. CVEs can also support intentional communication by providing users with a list of the other students with which they have strong ties and providing awareness on their availability.

2.3. Supporting information sharing

Any learning community relies on a patrimony of information that must be accessible as much as possible by all its members. CVEs can support learning communities by providing them with a space that can be enriched with artifacts conveying information, such as documents, folders, and postIts. This approach can have various benefits. First, the physical configuration of the space can be used to support navigation. For example, it is possible to put into a room all the documents connected to a certain topic and connect the room to other rooms that contains related documents. Second, the physical organization of the information can ease memorization. In fact, the spatial nature of memory is recognized in psychological theory. For example, the “method of loci” [25] is a technique for accessing information, where things are remembered by associating them with places or images. Third, according to Cicero (cited in [27]), when people visit a place, they not only remember what they did there, but also people they met there. Therefore, the support that space provides for the memory also provides the support for memory of encounters [11]. In addition, with a CVE is easy to provide support for the dynamic construction of the information space of the community, allowing the participation of all the members (if this is in accordance with the policies of the specific community at hand). Moreover, different levels of participations can be allowed. For example, some members can be allowed only to add comments in form of PostIts to the existing information, others to modify it, and others to add new information, e.g. to bring into the virtual environment new documents or to create external links.

2.4. Providing an alternative space structure

Research in social science indicates that space plays an important role in social life. According to [9], space is a key resource for establishing and enabling an activity. The concept of boundaries in this context is of critical importance for constraining access, marking territory and identifying locations for specific activities. Space allows different modes of participation in activities and awareness of them. Space also allows for negotiation of common resources.

However, the existing boundaries and structures of the physical space in campuses and schools do not always provide the optimal context for communication, group work and community development. CVEs can support learning communities by providing an alternative space structure. One that is more dynamic than the real one and that evolves with the community.

3. The metaphors used in educational CVEs

Spatial metaphors can be characterized along two orthogonal dimensions: their resembling of a real space, and the intended purpose of the space that they provide. In the following we use these two dimensions to present different metaphors.

3.1. Resemblance of physical space

Along this dimension metaphors are characterized in relation to their intent of creating a virtual space that resembles a real one, implying that the virtual environment provides an analogy to a part of the real world. In the following we consider only two of these metaphors because of their relevance in education. Many others exist where the provided virtual space resembles e.g., planets, ecosystems, and cities.

3.1.1. CVEs as buildings and campuses. Many systems have used buildings as metaphor for the virtual space. In this case, the virtual environment is presented as one or more connected buildings where users can meet and work. In particular, in the educational context, this metaphor has been specialized to recreate the experience of being in a campus. Several universities and schools introduced virtual representations of themselves (eCollege, VHS, Flo, Virtual Campus, Diversity University etc.) providing an analogy of the corresponding place in the real world ([1], [15], [16]). The rooms and the buildings of the campus give an idea about the social environment, personal office space, and available equipment. The analogy with the physical campus allows creating a virtual environment that is familiar to users and where they can easily move to meet

people, access learning materials, and retrieve information.

3.1.2. CVEs as frontiers. Frontiers can be thought of as land to claim and conquer, and horizons to extend. Many systems use this metaphor and are based on the idea of the virtual environment as landscapes to create and territories to claim [10, 23]. We can draw parallels between building a house in the prairies and creating a new virtual room [23]. Often the notions of power, status and competition are connected to the phenomena of frontiers as for example shown in the social experiment of DomeCityMOO, a text-based MOO, where the participating students have been assigned different building powers and possibilities for creating new places [20]. This metaphor is clearly present in the worlds of Active Worlds universes, among them also educational worlds of AWEDU (Active Worlds Educational Universe) where different groups of students “claim” land by building various objects (Euroland, Playgrnd) [1]. The metaphor of frontiers provides a significant amount of control on the structuring of space, which is often not present in the real world. Users get the opportunity to extend the limits of the space, acquiring new areas and establishing new places. The power of this metaphor is also in offering possibilities for interesting social simulation and experiments and creating an arena for exploration of power and identity, as in the case with DomeCityMOO.

3.2. Virtual places for specific purposes

In many CVEs the virtual space represents an abstraction designed to serve specific purposes, for example, for allowing people with similar interests to talk together or for providing visualizations of people’s engagements in certain tasks or access to certain information.

3.2.1. CVEs as meeting places. A meeting place in a CVE is an electronic container where meetings and related activities happen continuously over time [24]. The meeting place can be everything: textual MOOs (MOOSE Crossing [2]) and IRC, graphical 2D rooms for class parties (WorldsAway) [18], 3D meeting places for online designer classes in ActiveWorlds [7], or a combination of different media, both text and 3D, as in Virtual Campus [15,16]. For example, the textual environment of MOOSE Crossing allows children to meet virtually in a text-based environment [2]. Graphical meeting places, like WorldsAway and the worlds of the AWEDU, provide more advanced meeting facilities since it is possible to communicate not only by the means of text, but also through avatar movements, gestures and mimics. The

design of such places varies strongly depending on the purpose of the meeting, from the more formal environment of work (Virtual Campus) to the more informal surroundings of the Palace and WolrdsAway for class parties. Generally, the systems based on this metaphor provide a virtual meeting place designed to satisfy specific needs (separation according to interests, overview of the activities by others, means of communication, etc.) that contains a number of artifacts for facilitating the meetings, for example whiteboards and bulletin boards.

3.2.2. CVEs as information spaces. Due to the increasing information load in everyday life, there have been a number of attempts to combine information visualization and navigation with collaborative virtual environments. In these cases the virtual space is seen as an information space where data are visualized, often using 3D, and users can observe what data is accessed by other users and how it is done. An example that combines the principles of hypermedia together with the traditional campus metaphor is Virtual syllabus from Business Computing Skills Class [7]. The course is represented by a virtual environment in Active Worlds, which serves as a place or context for learning so that the learning is “anchored” in a 3D environment.

The success of these systems greatly depends on the navigation support that they provide. In particular, CVEs can support spatial, semantic and social navigation [8]. For example, in Virtual Syllabus the students walk around the physical landscape (spatial navigation) and follow various links to the parts of learning material (semantic navigation). In LEEP [22], social navigation is possible thanks to the support provided to users of offering and seeking advice for navigating the common information space.

3.2.3. CVEs as virtual stages. A virtual stage is a virtual place where some kind of acting takes place, either by the users themselves or by objects created by them. An example of educational systems using this metaphor is Klump, a 3D collaborative storytelling tool where children can manipulate a 3D object, called Klump, that can be assigned various shapes and properties to perform in the storytelling [3]. Another example is Teatrix, a collaborative virtual environment that allows children to collaboratively create stories on a virtual stage. The children prepare the scenes and the characters in a backstage and then collaboratively create the story in a 3D virtual world [14]. In the systems, based on this metaphor, people are represented by avatars or/and nicks. The audience can be TV-watchers [4], virtual worlds users or actors themselves who can watch their performance from the third person perspective.

3.2.4. CVEs as demonstrations and exhibitions. Some CVEs focus on providing a virtual place for the collaborative viewing and experimenting on various objects. Due to the increasing possibilities of multimedia and VR technology, 3D CVEs are to a greater degree used to demonstrate concepts that are difficult to represent efficiently enough in real life, for example complex physical phenomena or 3D geometry and arts. Even in cases where the material can be presented in 2D on paper, it appears more motivating to present it in 3D graphics and allow for collaborative exploration and modification of the material in a 3D CVE [28]. The Active Worlds educational universe includes a number of worlds based on this metaphor, for example VanGogh and GrMuseum for art exhibitions, and Awstruck demonstrating complex geometric concepts [1]. This metaphor is useful when it is necessary to exploit the media richness of virtual environments, mostly in 3D, since some concepts are better perceived when they are presented in three dimensions. It is feasible to use in the situations where it is for practical and safety reasons difficult to demonstrate the relevant phenomena in real life, for example certain physical experiments, historical places etc [28]. In such an environment the students can collaboratively manipulate objects in order to study complex concepts in a more direct and appealing way than just reading about them.

3.2.5. CVEs as shared workspaces. A virtual shared workspace is a virtual place where the users work in a shared context on a shared task using shared artifacts. The collaboration can be synchronous or asynchronous. In the systems adopting this metaphor the focus is on providing a space that can be used by people that are geographically distributed and cannot work together in a classroom, office, or laboratory. The main goal in this case is on providing access to working artifacts and on supporting the shared work that users have to perform.

There exist a number of worlds in AWEDU where students work collaboratively to create pieces of art, demonstrations, and exhibitions. Similarly, in Virtual Physics and Physics laboratory worlds students can collaboratively perform experiments and study different physical phenomena [28].

In this perspective CVEs provide new possibilities for facilitating collaborative work because they provide a common place with shared objects as well as because 3D technology provides new possibilities for observation of the shared space.

3.3. Comparison

The virtual environment provided by any CVE system can be classified according to the metaphor(s) that it

adopts for resembling real space and of the metaphors that are underlying its intended purpose. For example, Virtual Syllabus, described in Section 3.2.2, combines the building metaphor along the first dimension with the one of information space along the second. In fact, the different parts of the syllabus, i.e. the information space, are represented by buildings and places that are connected by paths and avenues, so the students are encouraged to “walk through” in a certain way and gather information as they move along. Some systems combine more than one metaphor along the same dimension in order to provide a richer arena for collaboration. For example, the workspace metaphor is often used together with the stage metaphor. For example, in Theatre of work [19,17], the workspace is represented as a stage where actions, interests and documents users work on are depicted in a symbolic way.

Combining different metaphors in educational CVEs is necessary because none of the described metaphors alone can meet the requirements suggested by the roles of CVEs described in Section 2. For example, a constant meeting place provides a context for establishing social contacts and communication, as well as an alternative structure for having meetings. The quality and flexibility of this alternative structure depends on the possibilities of extension and modification of the structure by the users. The 2D or 3D structure of non-textual spaces (buildings or abstract places) often allows spatial structuring of information, for example by placing various links and signs in the meeting locations. The basic navigation is provided, usually in form of movements within a room or between different rooms. However, to provide a more advanced navigation and the possibilities for an effective information sharing, the system should include the functionalities of the information space metaphor.

The “information space” metaphor alone does not always provide good possibilities for social engagement, establishing contacts and acquiring a general awareness of the social situation in the virtual environment, among others because the requirements of an information space itself often make it uncomfortable for all the users to share the same view of the space creating the need for “subjective” views [13]. In addition, in the CVEs employing this metaphor, the focus is often on the information itself, not the persons behind it, so it is important to strengthen the social aspect in such systems. However, this metaphor often offers a structure of the space, unattainable in real world and optimal for accessing a certain database or data structure of some kind.

The stage metaphor has some similarities with the meeting place and often provides the same functionality. Both role-playing and collaborative creation of stories has a number of important functions, like promoting the

communication and social relations between users and improving their writing, social and creative skills. The roles of the users may have various implications for the user's place in the social hierarchies of the virtual communities [12]. The support for the alternative structure is also provided to some degree, but there is practically no support for information sharing.

The workspace metaphor provides additional possibilities for communication and community building, especially for geographically distributed users. For example, in addition to textual and audio communication, the users may communicate by manipulating the shared artifacts in the common workplace, so that other users can track the changes. In some systems, like Nessie [19], the working space functions as a "theatre of work", signaling people's activities, interests and group memberships according to the tasks they work on and the interests they have. The systems using this metaphor often provide an alternative working place, with the functionalities adjusted to user's needs.

The demonstration metaphor is often used together with the workspace metaphor in the same system and provides similar functionalities, but the accent on collaboration and communication is generally weaker in the former. Thus, one of the main challenges in such systems is not focus too much only on the demonstrational abilities of CVEs, without paying enough attention to facilitating collaboration.

The metaphor that provides the best support for community building and alternative space is the frontier metaphor, as proved, e.g., in the trial "30 days in Activeworlds", where a whole community was created during a month [10]. By allowing the whole system to develop and grow relatively free, it is possible to obtain indications about the structure and the relations within the community as well to explore its power and identity relations.

4. Conclusions and future work

In this paper we have discussed the roles of CVEs in supporting learning communities. We have also looked at the various spatial metaphors used in the educational CVEs and analyzed their ability to address the needs of the learning communities. As discussed, no one of the metaphors alone is sufficient for the purposes of the learning community. Rather, it is necessary to combine the different features of the described metaphors into a new one, tailored to the specific needs of particular user groups. The future work will be therefore to develop such a metaphor.

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