

# Collaborative Virtual Environments

**Thrasyvoulos Tsiatsos**

*Aristotle University of Thessaloniki, Greece*

**Andreas Konstantinidis**

*Aristotle University of Thessaloniki, Greece*

## INTRODUCTION

Computer supported collaboration is one of the most promising innovations to improve teaching, learning, and collaborating with the help of modern information and communication technology (Lehtinen & Hakkarainen, 2001). Continuous enhancements in computer technology and the current widespread computer literacy among the public have resulted in a new generation of users (less so in developing countries) that expect increasingly more from their e-learning experiences. To keep up with such expectations, e-learning systems have gone through a radical change from the initial text-based environments to more stimulating multimedia systems (Monahan, McArdle & Bertolotto, in press).

Generally a collaborative virtual environment (CVE) can be defined as a computer-based, distributed, virtual space or set of places. In such places, people can meet and interact with others, with agents (artificial intelligence), or with virtual objects. CVEs might vary in their representational richness from 3D graphical spaces, 2.5D and 2D environments, to text-based environments. Access to CVEs is by no means limited to desktop devices, but might well include mobile or wearable devices, public kiosks, and so forth (Churchill, Snowdon & Munro, 2001). CVEs are a subset of Virtual Environments (VEs) in that only VEs which support collaborative operations can be considered CVEs. The two primary uses of CVEs are for collaborative learning and/or collaborative work in either educational and/or professional environments.

Computer supported collaborative learning (CSCL) is an umbrella term for a variety of approaches in education that involve the joint intellectual effort by students or students and teachers and that require the use of computer and communication technology. Researchers (e.g., Ahern, Peck & Laycock, 1992; Bruckman & Hudson, 2001; Singhal & Zyda, 1990) have proven the effectiveness of collaborative learning compared to other educational practices (e.g., competitive or personalized learning), praising this method's way of aiding the acquisition of higher level cognitive abilities, problem solving abilities, ease in scientific expression and the development of communication, social and higher order thinking skills.

The most important advantages of using CSCL are discussed in Bruckman et al. (2002). It is mentioned that

through CSCL teacher/student interactions become more balanced and that there is also some evidence to suggest that gender differences are reduced in online environments. In addition, students exhibit higher levels of attention and appear more honest and candid toward those in a position of authority. Learning becomes more student-oriented, thus increasing the likelihood that students will absorb and remember what they learn.

On the other hand, computer supported collaborative work (CSCW) is a generic term, which combines the understanding of the way people work in groups with the enabling technologies of computer networking, and associated hardware, software, services and techniques (Wilson, 1991). Although some authors consider CSCW and groupware as synonyms, others argue that while groupware refers to real computer-based systems, CSCW focuses on the study of tools and techniques of groupware as well as their psychological, social, and organizational effects. For example, researchers Hiltz and Turoff (1993) conclude that the social connectivity of users who adopt a computer-mediated communication system increases notably. They also found a strong tendency toward more equal participation, and that more opinions tended to be asked for and offered.

The purpose of this chapter is to present a concise yet complete overview of collaborative virtual environments. In the following sections we will discuss the technological evolution of CVEs, their basic characteristics and architectures, and the tools and services integrated within them. Finally, there will be a brief mention of the design challenges facing CVE designers and of future trends with which CVE functionality will be extended.

## BACKGROUND

The first virtual worlds were text based, in that their environments and the events occurring within them were described using words rather than images. Their primary use was for entertainment and specifically as fantasy role-playing games. Virtual worlds are often called MUDs (Multi User Dungeons) because MUD was the name of the first one to prosper. Its author was Roy Trubshaw. In 1989, TinyMUD was one of the first virtual worlds to focus on the social aspects of these environments. Users could create new locations and objects,

spending most of their time creating and talking about their creations. In 1990 MOO (MUD, Object Oriented), introduced a fully functional scripting language and allowed users of social-oriented virtual worlds to add not only objects, but also powerful functionality to the environment as it ran. MOO's descendents have found a niche in the educational world, as they are easy to use and can demonstrate the principles of programming to new users. Also in 1990, TinyMUSH, among other things, introduced event triggering and software automatons (known as puppets then and as agents today). In 1993, before the advent of the World Wide Web, MUDs constituted some 10% of the Internet (Bartle, 2004).

Text based collaboration started around 1990 with a system called "Reality Built for Two"; there is one system in 1987 by Sim et al. which can be classified as a Collaborative Virtual Environment, but was built using dedicated hardware for military training purposes (Joslin, Di Giacomo & Magnenat-Thalmann, 2004). It is interesting to note that CVE systems have been around long before the World Wide Web was invented, but have not been used as extensively by the general public for personal or commercial activities. This is possibly because of their complexity and base requirements being much more demanding, or possibly the content being much harder to create. Reality Built for Two (RB2) was a development platform for designing and implementing real-time virtual realities (Blanchard & Burgess, 1990). Development was rapid and interactive in RB2. Behavior

constraints and interactions could be edited in real time with the system running. Changes made to interactions in the world were seen immediately in Virtual Reality (VR). The primary user input devices in use in RB2 were the DataGlove which allowed gestural and direct manipulation of the environment, and the Polhemus tracker for head tracking.

After 1990, the popularity of CVEs remained almost stable with the appearance of three to four new systems each year. A more substantial increase in popularity was observed in 1995 with the release of systems such as RING, Virtual Society, MASSIVE and SmallView. CVE popularity peaked in 1997 with new developments generally falling off ever since (Joslin et al., 2004). It seems 1997 can be seen as the point of maturity for CVEs. The decline of the scientific community's interest in the theoretical basis of CVEs has seen a rise in commercial CVE products today. Contemporary systems include Active Worlds (released in 1997), There (released in 2003, <http://www.there.com/>), I-maginer (<http://www.i-maginer.fr>), Workspace3D (<http://www.tixeo.com>), Second Life and Croquet.

The most successful CVE today seems to be Second Life with over four million total sign-ups. Released in 2003, the Internet-based virtual world Second Life (SL, <http://secondlife.com/>) came to international attention via mainstream news media in late 2006 and early 2007. Users in SL can explore, meet other users, socialize, participate in individual and group activities and create and trade items

Table 1. The CSCW matrix

	Same Time (synchronous)	Different Time (asynchronous)
Same Place (collocated)	<p><b>Face-to-face interactions</b> – decision rooms, single display groupware, shared table, wall displays, room ware ...</p>	<p><b>Continuous task</b> – shift work groupware, project management, and so forth</p>
Different Place (remote)	<p><b>Remote interaction</b> – video conferencing, instance messaging, chats/ MUDs/ virtual worlds, shared screens, multi-user editors, and so forth</p>	<p><b>Communication and coordination</b> – email, bulletin boards, blogs, asynchronous conferencing, group calendars, workflow, version control, wikis, and so forth</p>

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