

Collaborative Learning On-Demand

Giancarlo Fortino

DEIS - Università della Calabria, Italy

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INTRODUCTION

Advances in communications and software technology are leading the Internet to become an open and distributed computing platform able to provide diversified services which can be ubiquitously accessed by many users.

Electronic learning-oriented services are well suited to be supported by and delivered through the Internet. They are strategic for enabling virtual universities, enhancing the skills of the employees of a company, and facilitating auto-training.

Nowadays, a multitude of networked e-learning systems and applications, which can be usefully employed to support distance learning, have been developed. They are basically based either on asynchronous learning models or on synchronous learning models (see Table 1). Specifically, “virtual or real” collaborative learning environments are particularly interesting in the education research area since they are aimed at creating computer-based and multimedia-oriented learning processes where learners, that belong to a collaborative and interactive group, cooperatively construct knowledge (Costantini & Toinard, 2001).

In fact, it has been proved that instructional methods promoting interpersonal discourse and social construction of knowledge (i.e., collaborative learning techniques) are more effective than methods which simply rely on the broadcast of information (classroom transmission metaphor) or on the asynchronous, self-paced access to online training materials (Cohen, 1994).

In this article, an overview of the *Collaborative Learning On-Demand (CLOD)* paradigm along with its supporting technology (Fortino & Nigro, 2003) is presented.

In particular, the VICRO^c system, which fully supports the CLOD paradigm, is described. Finally, the usability evaluation of VICRO^c is shown. The carried out experiments confirmed that the CLOD paradigm has the potential to improve the learner’s productivity.

BACKGROUND

Collaborative Learning on-Demand (CLOD) is a virtual collaborative learning paradigm which enables a self-tutored, interactive and cooperative learning process where a small group of remote students requests, watches and controls the playback of an archived lecture by exchanging questions with each other (Fortino & Nigro, 2003).

CLOD borrows some of the ideas of:

- *Tutored Video Instruction (TVI)*, which is a face-to-face collaborative learning methodology in which a small group of students driven by a tutor goes over a videotape of a lecture;
- *Distributed Tutored Video Instruction (DTVI)*, which is a fully virtual version of TVI, in which each student has a networked computer equipped with audio (microphone and headset) and video (camera) facilities to communicate within a group.

Table 1. Asynchronous vs. synchronous distance learning

	SYNCHRONOUS	ASYNCHRONOUS
MODEL	The teacher and the student interact with each other in “real time”.	The teacher may deliver the instruction via video, computer, or other means, and the students respond at a later time.
TECHNOLOGY	VideoConferencing, AudioConferencing, Internet Chat, Desktop Videoconferencing, Whiteboard	Video Tape, Broadcast Video, E-mail, CD-ROM, WWW-based courses
EXAMPLE	Using a two-way video conferencing tool, students interact with “live” video of an instructor.	Instruction may be delivered via the Web or videotapes, and the feedback could be sent via e-mail messages.

Table 2. A comparison between CLOD and DTVI

FEATURE	CLOD	DTVI
LEARNING TYPE	SELF-TUTORED	TUTORED
GROUP SIZE	SMALL/MEDIUM (≤ 20)	SMALL (≤ 5)
CONTROL OF THE VCR	SHARED AMONG STUDENTS	APPLIED BY THE TUTOR
SUPPORTING TECHNOLOGY	COOPERATIVE PLAYBACK SYSTEMS	CONFERENCING SYSTEMS

TVI and DTVI have proven real effectiveness in that the students involved in their experimentation have been shown to outperform students who physically attended the lectures (Sipusic, Pannoni, Smith, Dutra, Gibbons, & Sutherland, 1999).

The substantial difference between CLOD and DTVI (see Table 2) is that CLOD methodology does not assume the presence of a tutor which guides students to construct knowledge. This fact has a direct impact on the technical implementation of CLOD because, while in DTVI only the tutor has control of the videoconference recorder (VCR), in CLOD each participant to the playback session uses a shared VCR remote controller. In addition, being the learning service on-demand, CLOD needs to be supported by a video on-demand system (VoD).

The CLOD paradigm is supported by the Cooperative Playback Systems (CPS; Fortino & Nigro, 2000) which are media on-demand systems providing cooperative playback sessions. In a cooperative playback session, the participants, who are explicitly grouped, share the vision and the control of a multimedia session streamed by a media server, and interact with each other by means of a question board.

The construction of CPS is efficiently enabled by the IP multicast technology which concurs to save network resources (e.g., bandwidth) and improve scalability (Kumar, 1996). IP multicast allows for the transmission of a packet to a group of hosts which are identified by a multicast address belonging to the class D of IP addresses. The worldwide testbed of IP-multicast is MBone (Multicast Backbone; Kumar, 1996) which, to date, cannot be accessed by all the users of Internet. However, private IP multicast-enabled networks (campus networks or intranets) can be easily set-up. IP multicast has promoted the proliferation of a rich set of multimedia applications, systems and protocols able to support synchronous distance learning over the Internet according to the real/virtual classroom metaphor (Costantini & Toinard, 2001; Crowcroft, Handley, & Wakeman, 1999; Kumar, 1996).

In particular, a CPS can be developed by integrating two enabling MBone-based technologies:

- *VideoConference Recording on-Demand (VCRoD) systems.* They are VoD-like systems which allow a user to connect to a Media Server (MS) and request two kinds of services: recording and playback (Fortino & Nigro, 2003; Holfelder, 1997; MLB, 2001; Parnes, Synnes & Schefstrom, 2000; Shuett, Raman, Chawathe, McCanne & Katz, 1998). Upon requesting a recording service, users can either select a media session being transmitted over an IP-multicast address or send their own media session directly to the MS. This way, the MS archives the media session in a multimedia repository. On the other hand, the playback service allows users to browse the list of the archived media sessions, select a particular media session and control its playback by means of a VCR remote controller. In Table 3, the description of three main VCRoD systems is given.
- *MBone tools.* They are multimedia applications enabling a group of users to interactively and synchronously exchange audio/video “live” streams, text-based messages, and to cooperatively share whiteboards and document editors (MASH Consortium, 2003; MBT, 2003; Parnes, Synnes & Schefstrom, 2000).

To date, a few trials have been devoted to building CPS. The most significant contributions in this direction are the VICRO^c system (Fortino & Nigro, 2003), and the MASH Rover system (MASH Consortium, 2003; Shuett, Raman, Chawathe, McCanne & Katz, 1998).

In particular the VICRO^c system addresses all the features of a CPS whereas the MASH Rover system only provides basic services.

VICRO^c: A COOPERATIVE PLAYBACK SYSTEM FOR CLOD

The main functionalities of the VICRO^c system can be summarized as follows.

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