

## Chapter 2.29

# Intelligent Agents Supporting Distributed Collaborative Learning

**Weiqin Chen**

*University of Bergen, Norway*

**Barbara Wasson**

*University of Bergen, Norway*

### **ABSTRACT**

In the context of distributed collaborative learning, it is usually difficult for students to be aware of others' activities and for instructors to overview the process and regulate the collaboration. In order to facilitate collaborative learning, intelligent agents were developed to support the awareness and regulation of the collaboration. This chapter discusses the facilitation role of intelligent agents and how they support students and instructors in distributed collaborative-learning environments. By monitoring the collaboration, the agents compute statistics, detect possible problems, and give advice synchronously and asynchronously to the students and instructor based on their activities and requests. In so doing, the agents not only

help students to self-regulate their activities but also help instructors to maintain an overview of the collaboration so that they can intervene when necessary.

### **INTRODUCTION**

Agent technology has been used in educational environments for some time, and a number of agents and multiagent systems have been designed specifically for educational purposes. In these systems, agents play different roles, such as tutors (Johnson et al., 2000) or co-learners (Chan, 1996). Another role for an agent is that of a facilitator (Chen & Wasson, 2003). For example, in a distributed collaborative-learning environment where users are geographically distributed

and collaborate through a Web-based learning environment, an agent can facilitate collaboration processes such as coordination, teacher intervention, group interaction, etc.

In computer-supported collaborative work (CSCW), facilitation was studied in group supporting systems (GSSs) (Hirokawa & Gouran, 1989; Pollard & Vogel, 1991; Antunes & Ho, 1999). The activities of the facilitator in supporting group work have been identified. They are, among others, ensuring member identity and maintaining a discussion focus and a procedure for that focus; ensuring everyone has an opportunity to contribute to the discussion and decision regarding focus, procedures and decision issues; providing structure to focus group limits and boundaries; intervening when appropriate; and maintaining awareness of own feelings as an indicator (Chilberg, 1989; Shelli & Hayne, 1992). The facilitator is thought of as a servant to the group rather than a master (Jay, 1976). In the context of distributed collaborative learning, where students and instructors are geographically distributed, intelligent agents have been developed to support group learning (Okamoto et al., 1995; Ayala & Yano, 1996; Dillenbourg et al., 1997; Soller, 2001). Our research is partially inspired by these previous works and aims at testing the facilitation role of agents in both synchronous and asynchronous environments. It is also inspired by work on awareness within the CSCW field (Dourish & Bellotti, 1992; Gutwin et al., 1995).

In the DoCTA-NSS project (<http://intermedia.uib.no/projects/docta>), we developed intelligent agents for both asynchronous (Chen & Wasson, 2002) and synchronous (Dragsnes et al., 2002) collaborative-learning environments and used these environments to support student collaboration in a learning scenario on gene technology, where Grade 10 students in two Norwegian cities collaborated through a groupware system.

The chapter is organized as follows. After the background of facilitation agents in distributed collaborative learning, Section 2 discusses design

issues of agents in distributed collaborative-learning environments, including problems that often occur in the collaboration process, awareness, and how to present the awareness information and advice effectively and nonintrusively. Sections 3 and 4 describe the agents integrated in FLE3 (asynchronous environment) and in the Mindmap Building Tool (synchronous environment). The design, development, integration with the environments, and evaluation of these agents will be described in detail in these two sections. Related work is discussed and compared with our research in Section 5. Section 6 provides our conclusions and future work.

## **DESIGN ISSUES OF INTELLIGENT AGENTS AS FACILITATORS**

In this section, we discuss design issues of facilitator agents in distributed collaborative-learning environments, including problems that often occur in the collaboration process, awareness, and how to present the awareness information and advice effectively and nonintrusively.

### **Software Agents and Pedagogical Agents**

The term “agents” has been used in a variety of fields of computer science and artificial intelligence. It has been applied in many different ways in different situations for different purposes. However, there is no commonly accepted notion of what it is that constitutes an agent. As Shoham (1993) pointed out, the number of diverse uses of the term “agent” are so many that it is almost meaningless without reference to a particular concept of agent.

Many researchers have attempted to address this problem by characterizing agents along certain dimensions. For example, Franklin and Graesser (1997) constructed an agent taxonomy aimed at identifying the key features of agent sys-

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