Chapter VI
Cognitive Models Applied to Built Intelligent Educational Applications

Lucia Maria Martins Giraffa
Pontifical Catholic University of Rio Grande do Sul (PUCRS), Brazil

André Luís Alice Raabe
Itajaí Valley University, Brazil

ABSTRACT

This chapter presents the results of a 10 years research focused on building intelligent tutoring systems (ITS) that aims to represent student’s knowledge without classifying it with predefined stereotypes. We adopted the mental states approach as an alternative to achieve this goal. By modeling students using a multiagent BDI (belief desire intention) architecture, the student knowledge is considered the way it is. The results of the experiment, conducted with a multiagent learning environment to teach ecology for children, reinforced our beliefs about this type of modeling students; however, it points out the need of better mediation actions to guide students interaction. Searching to improve mediation, we decided to experiment with a novel approach in ITS research: to include the teacher as an end user. The results of this ongoing work are also presented in this chapter.

INTRODUCTION

In the last 10 years, we have been exploring a new challenge that arose for computer intelligent educational environments: to make possible more than one student interacting with the same environment under artificial tutor supervision. From the educational point of view, this is not a new idea. However, it became feasible through the development of hardware and software that allows us to connect people using computer networks and related technologies. The impact
of these technologies on educational software research was immediate. The researches have begun to introduce these new possibilities to improve educational environments.

Nevertheless, the student model remains the weakest part of such systems. There are many factors that contribute to this weakness (hardware and software limitation, techniques to model the student, knowledge representation, and others). However, the strongest restriction is our imprecise knowledge about the mental activities of the students during teaching/learning process. In order to build an ITS (intelligent tutoring system) with a good student model, we must understand what is happening in the student’s mind during the interaction process. We need to understand the process and reproduce it in the machine. Much has been done to understand this mechanism, according to different approaches: psychological, educational, and computational. The current technology and our limited knowledge about the human learning process still do not allow us to build the ideal ITS. At this moment, the researchers’ efforts to find a computational theory that explains the human information processes have not produced the appropriate answers. In fact, we do have models that try to explain how the information is processed in the human mind. Nevertheless, those models do not allow us to detail the process at the level that we need. We now have different tools and new possibilities. We believe that the multimedia techniques and agents programming paradigm are some of these new technologies that may transform the way we will redesign ITS.

Many systems for educational purposes have adopted agents’ paradigm to better explore the interaction and dynamic changes in teaching-learning environments. As Khuwaja (Khuwaja, Desmarais, & Cheng, 1996) said, even though intelligent tutoring systems have been implemented with relative success, they are not practical enough to be used in the real world. The restrictions of these systems can be overcome when we attempt to introduce the notion of cooperation in the teaching-learning process using a multiagents focus. Using the agent’s paradigm and mental state choreography to improve the student model and the interactions between tutor and students is a new possibility that arose with Corrêa’s (1994; Corrêa, & Mendes, 1995) work. Another experiment built by Moussalle (Moussalle, Vicari, & Correa, 1996) showed that it is possible to trace some student’s mental activities using this approach. Our work (described in this chapter) modeled student’s mental states during a tutoring section. After this, Jaques and Vicari (2007) presented an approach to model student’s emotion using mental states. Recently, new tools, such as Jason (Bordini & Hübner, 2006), are allowing to rapidly program agents using the mental states approach.

In our first investigation, we adopted a mentalistic approach. On this approach, the term agent means a computer system that can be viewed as a set of mental states, such as beliefs, intentions, motives, expectations, obligations, and so on. In this case, the question of what an agent is, is replaced by the question “what entities can be viewed as possessing mental states?” We change the focus from “what can be viewed as an agent in ITS?” to “all ITS module that can be designed as an agent,” and the point is “what will be the degree of mental tracking we will use.” In this case, we will trace the student’s activities in a very detailed level.

The mental state approach we adopted is based on the classical argument by Dennet (1987) and McCarthy (1978). Dennet proposes what he calls the “intentional stance,” where systems are ascribed mental qualities such as intentions and beliefs. According to him, the important aspect is not whether those systems are really intentional, but if they can be coherently described as if such. McCarthy, in his turn, makes a distinction between the legitimacy and the usefulness of ascribing mental qualities to systems. For him, it is legitimate to ascribe mental states such as beliefs, intentions, abilities, and so on, when there is a correspondence to their common-sense coun-