

## Chapter 17

# Intelligent LMS with an Agent that Learns from Log Data in a Virtual Community

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### ABSTRACT

*This study describes an agent that acquires domain knowledge related to the content from a learning history log database in a learning community and automatically generates motivational messages for the learner. The unique features of this system are as follows: The agent builds a learner model automatically by applying the decision tree model. The agent predicts a learner's final status (Failed; Abandon; Successful; or Excellent) using the learner model and his/her current learning history log data. The constructed learner model becomes more exact as the amount of data accumulated in the database increases. Furthermore, the agent compares a learner's learning processes with "Excellent" status learners' learning processes stored in the database, diagnoses the learner's learning processes, and generates adaptive instructional messages for the learner. A comparison between a class of students that used the system and one that did not demonstrates the effectiveness of the system.*

### INTRODUCTION

The constructivist approach has pervaded the area of educational technology in recent decades. It has been argued in this approach that the responsibility for learning should be increasingly with the learner (Von Glasersfeld, 1995). Therefore, the role of instructor has changed to facilitator from that of teacher (Bauersfeld, 1995). A teacher gives

a didactic lecture that covers the subject matter, but a facilitator assists the autonomous learning process. The learner plays a passive role in the former scenario and in the latter the learner plays an active role in the learning process. The emphasis thus shifts from the instructor and content-centred approach toward the learner-centred approach (Gamoran, Secada & Marrett, 2000).

A central feature of this facilitation is individualizing learners and helping them to achieve self-growth through self-evaluation and coopera-

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tion with others (Merriam & Brockett, 2007). For example, according to the well known theory by Knowles, facilitation is designing a pattern of learning experiences, conducting these learning experiences with suitable techniques and materials, and evaluating the learning outcomes and rediagnosing learning needs (Knowles, 1983) (Knowles, Holton & Swanson, 1998). e-Learning, which emerged as a method of attaining the learner-centred approach, provides a new autonomous-learning environment that combines 1. multimedia content, 2. collaboration among learners, and 3. computer-supported learning (Ueno 2007). e-Learning should work even if there is no human facilitator and a huge number of learners participate in it. It would essentially be impossible for facilitators to individualize such a huge number of learners and facilitate their learning. The main idea in this chapter is that a computational agent in a Learning Management System (LMS) plays the role of facilitator instead of human teachers. The proposed agent uses the learners' history data in a learning community, which is stored in a database, to compare the learning process of the learner with that of the past excellent learners. A computational agent that learns using the decision tree model, one of machine learning or data-mining technologies, from data is called a "learning agent".

The decision tree model (Quinlan, 1986), which is a well-known method that is equivalent to the Bayesian belief network, enables users to obtain valid results even if the number of variables in the tree increases significantly, although interpreting the meaning of a structure is more difficult than in the Bayesian belief network.

Building a meaningful model requires a number of variables for representing a learner's status. For these reasons, in this study we used an intelligent agent based on the decision tree model and installed it into an LMS. The unique features of this system are summarized as follows.

1. The agent builds a learner model automatically by applying the decision tree model.
2. The agent predicts a learner's final status (1. Failed; 2. Abandon; 3. Successful; or 4. Excellent) using the learner model and his/her current learning history log data. The constructed learner model becomes more exact as the amount of data accumulated in the database increases.
3. The agent compares a learner's learning processes with excellent learners' learning processes in the database, diagnoses the learner's learning processes and generates adaptive instructional messages for the learner.

It should be noted that the learner model strongly reflects the learning culture of the community because the model was built using log data of the past learners.

In addition, some previous research on learning motivation found that the effects of a mentor's motivational messages were adapted to a learner's status in e-Learning. Visser and Keller (1990) reported that motivational messages could reduce dropout rates and later attempted to improve motivation in e-Learning situations using such messages (Visser, Plomp, and Kuiper, 1999). Gabrielle (2000) applied technology-mediated instructional strategies to Gagne's events of instruction and demonstrated how these strategies affected motivation. Thus, agent messages are also expected to be effective in facilitating learner motivation.

The developed LMS with the agent system was compared with one without it in actual e-learning classes for one semester. The results showed that a much lower number of students withdrew from classes when the LMS with the agent system was used. In addition, the average score of the final test was significantly higher in the case of the LMS with the agent system. Answers to questions and interviews with learners showed that the agent system enhances learners' motivation and contributes to learners' maintaining a constant learning pace

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