

# Chapter 11

## Bringing AI to E-Learning: The Case of a Modular, Highly Adaptive System

**K. Giotopoulos**

*University of Patras, Greece*

**C. Alexakos**

*University of Patras, Greece*

**G. Beligiannis**

*University of Patras, Greece*

**A. Stefani**

*University of Patras, Greece*

### ABSTRACT

*This paper presents a newly developed student model agent, which is the basic part of an e-learning environment that incorporates Intelligent Agents and Computational Intelligence Techniques. The e-learning environment consists of three parts, the E-learning platform Front-End, the Student Questioner Reasoning and the Student Model Agent. The basic aim of this contribution is to describe in detail the agent's architecture and the innovative features it provides to the e-learning environment through its utilization as an autonomous component. Several basic processes and techniques are facilitated through the agent in order to provide intelligence to the e-learning environment.*

### 1. INTRODUCTION

One of the main characteristics of e-learning is user-centricity. Thus seeking effective user-centered design and implementation techniques is a significant goal. User-centricity has many forms; one of the most important is adaptation to

user behavior. Recommender techniques are the spearhead of adaptation research; they have been applied to numerous application areas with significant success, especially in e-commerce. Although, recommender techniques have been considered in a wide range of recent research efforts, they are mainly focused on lessons learned from the

DOI: 10.4018/978-1-61350-468-0.ch011

e-commerce domain. The same techniques, with minor variations are being used in e-learning. The analogy is not as straight forward as it is widely accepted since many concepts are fundamentally different. E-learning has many common characteristics with e-commerce applications and many differences as well: a learner does not behave always as a buyer does.

One of the main goals of e-learning adaptation is how to improve learning efficiency. One possible solution is to promote a personalized learning experience—which could be used as reinforcement to the foundations laid by the linear structured text books and the on-line and off-line lectures. The classic information transfer paradigm used in most e-learning applications is well understood and well supported by existing practice. In order to advance effective learning we will promote another paradigm that focuses on the learner and on new forms of learning. In our approach the learner has an active and central role in the learning process. Learning activities are aimed at facilitating the construction of knowledge and skills in the learner, instead of the memorization of information. Information transfer still exists in the new paradigm, but only as a simple component, not the main goal.

In this paper we describe an innovative web-based Intelligent Tutoring System (ITS) that introduces Artificial Intelligence (AI) techniques and agents technology in order to enhance the performance and the effectiveness of the e-learning system. In section 2 there is a structured presentation of the main issues related to the concept of an e-learning system, the state-of-the-art concerning the functionalities of an e-learning environment and the scientific subjects that the proposed solution focuses on. In section 3 the description of the proposed system is presented, while in section 4 the innovative features of the agent's integration are described and specified. In section 5 the student model agent architecture of the proposed system is described, while in section 6 the rule optimization module (concerning the updating procedure

of the student model and the Bayesian Network's decision rules) is presented. Finally in section 7 conclusions and future work are presented.

## **2. STATE OF THE ART**

Adaptive e-learning systems often employ models of the user. A user model is a representation of the user's properties and characteristics. Before a user model can be used it has to be constructed. This process requires much effort especially for gathering the required information and for generating a model of the user.

The behavior of an adaptive system varies according to the data from the user model and the user profile. In (Koch, 2000) there is a description of the necessity of applying user models as follows: "Users are different: they have different background, different knowledge about a subject, different preferences, goals and interests. To individualize, personalize or customize actions a user model is needed that allows for selection of individualized responses to the user."

In the context of e-learning, adaptive systems are more specialized and focus on the adaptation of the learning content and its presentation. According to (Mödrtscher et al., 2004), an adaptive system focuses on how the knowledge is learned by the student and pays attention to learning activities, cognitive structures and the context of the learning material.

In Figure 1, the structure of an adaptive system, according to (Brusilovski & Maybury, 2002) with three stages during the process of adaptation is shown. It controls the process of collecting data about the user, the process of building up the user model (user modeling) and the adaptation process.

The system proposed in this contribution is also three staged, it is an Intelligent Tutoring Systems (ITS). ITSs are adaptive instructional systems applying artificial intelligence (AI) techniques.

11 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:  
[www.igi-global.com/chapter/bringing-learning-case-modular-highly/61240](http://www.igi-global.com/chapter/bringing-learning-case-modular-highly/61240)

## Related Content

---

### Factors Affecting the Adoption of Educational Technology

Graeme Salter (2005). *Encyclopedia of Distance Learning* (pp. 922-929).

[www.irma-international.org/chapter/factors-affecting-adoption-educational-technology/12211](http://www.irma-international.org/chapter/factors-affecting-adoption-educational-technology/12211)

### An Economic Model for Evaluating Costs and Benefits for Distance Education Programs

Jared Bucker (2009). *Encyclopedia of Distance Learning, Second Edition* (pp. 741-745).

[www.irma-international.org/chapter/economic-model-evaluating-costs-benefits/11832](http://www.irma-international.org/chapter/economic-model-evaluating-costs-benefits/11832)

### A Virtual Laboratory for Digital Signal Processing

Chyi-Ren Dow, Yi-Hsung Liand Jin-Yu Bai (2007). *Future Directions in Distance Learning and Communication Technologies* (pp. 171-188).

[www.irma-international.org/chapter/virtual-laboratory-digital-signal-processing/18751](http://www.irma-international.org/chapter/virtual-laboratory-digital-signal-processing/18751)

### Exploring the Peer Interaction Effects on Learning Achievement in a Social Learning Platform Based on Social Network Analysis

Yu-Tzu Lin, Ming-Puu Chen, Chia-Hu Changand Pu-Chen Chang (2017). *International Journal of Distance Education Technologies* (pp. 65-85).

[www.irma-international.org/article/exploring-the-peer-interaction-effects-on-learning-achievement-in-a-social-learning-platform-based-on-social-network-analysis/181704](http://www.irma-international.org/article/exploring-the-peer-interaction-effects-on-learning-achievement-in-a-social-learning-platform-based-on-social-network-analysis/181704)

### Evaluating a Distance Education Program

Catherine Schifterand Dominique Monolescu (2004). *The Distance Education Evolution: Issues and Case Studies* (pp. 163-184).

[www.irma-international.org/chapter/evaluating-distance-education-program/30305](http://www.irma-international.org/chapter/evaluating-distance-education-program/30305)