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Adaptive intelligent tutoring systems for e-learning systems

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Abstract

An e-learning system is increasingly gaining popularity in the academic community because of several benefits of learning anywhere anyplace and anytime. Most frequently it seems to be used for web-based instruction so that learners can access online courses via internet. One likely reason for the lack of success is that just placing lecture notes on the internet does not train. This situation can be improved through the use of training software such as Intelligent Tutoring Systems (ITS). ITS incorporate built-in expert systems in order to monitor the performance of a learner and to personalize instruction on the basis of adaptation to learners' learning style, current knowledge level, and appropriate teaching strategies in e-Learning systems. While Adaptive Hypermedia systems (AH) do provide instruction in skills, it is generally less advanced than comparable ITS instruction. E-learning systems are web-based learning so that learners can access online courses via Internet without adaptation based on Learners' behavior. Therefore, it is a challenge to make e-Learning systems to be more "adaptive". Both ITS and AH are normally used for computer-based instruction**.** However, adaptive hypermedia is better suited for the instruction of concepts whereas intelligent tutoring system generally assists in the use of these concepts to solve problems. Therefore, a general instruction system requires both of these instructional approaches in order to provide a full learning environment. In this paper, describes a conceptual for combining ITS and AH into Adaptive Intelligent Tutoring System (AITS) for e-learning systems that allows knowledge to be stored in such a way that is not only independent of the knowledge domain, but also supports the storage of transfer knowledge relationships and prerequisite knowledge relationships. The conceptual results show that this innovative approach is helpful to the learners in improving their learning achievements.

Keywords : Intelligent tutoring systems; adaptive hypermedia; e-learning systems.

1. Introduction

E-learning is a means of education that incorporates self-motivation, communication, efficiency, and technology. Because there is limited social interaction, learners must keep themselves motivated. The separation intrinsic to e-learning requires learners to communicate with each other and the instructor frequently to perform their assigned tasks. E-learning is competent as it eliminates distances and subsequent commutes. Distance is eliminated because the e-learning content is designed with media that can be accessed from properly equipped computer terminals and most frequently it seems to be used for web-based instruction so that learners can access online courses via internet.

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E-learning is helpful to education, corporations and to all types of learners. It is affordable, saves time, and produces measurable results. E-learning can be defined as learning using electronic means: the acquisition of knowledge and skill using electronic technologies such as computer and Internet-based courseware and local and wide area networks another definition of e-learning is as education via the Internet, network, or standalone computer. E-learning is essentially the network-enabled transfer of skills and knowledge E-learning refers to using electronic applications and processes to learn (Rodica and Anca, 2009).

E-learning applications and processes include Web-based learning, computer-based learning, virtual classrooms and digital collaboration. Content is delivered via the Internet, intranet/extranet, audio or video tape, satellite TV, and CD-ROM E-Learning, focuses on the individual's acquisition of new knowledge and the technological means to support this construction process. Simulations close to the real world are the answer to constructivist learning theories, demanding situated learning with a high degree of engagement of the learner. One likely reason for the lack of success is that just placing lecture notes on the internet does not train. A potential solution to this problem is the use of training software such as Intelligent Tutoring Systems (ITS) with built-in artificial intelligence.

E-Learning, focuses on the individual's acquisition of new knowledge and the technological means to support this construction process. Simulations close to the real world are the answer to constructivist learning theories, demanding situated learning with a high degree of engagement of the learner (Rodica and Anca, 2009). Learning process can be seen as a process for:

- acquiring information;
- acquiring information and processing experience;
- acquiring information and processing experience that effects a long-term change in the consciousness of the learner;
- acquiring information and processing experience in which the learner integrates new information and experience into his/her current knowledge base;
- acquiring information and processing experience in which the learner perceives, selects and integrates new information and experience into his/her current knowledge base, thereby changing it;
- acquiring information and processing experience, in which the learner selects and constructs knowledge that is useful and appropriate for him/herself and in turn uses this to drive and determine his/her own continuous learning process;
- learning that becomes an individual process of interaction between the individual and his/her environment, in which the subjective reality of the learner is actively constructed.

This paper describes a conceptual for integrating ITS and AH components into AITS for e-learning systems. Background information on these areas is described, before the motivation and methodology of this paper is expanded upon. Finally, the conclusions are presented.

2. Background

2.1 Intelligent Tutoring systems

The approach known as ITS has been pursued by researchers in education, psychology, and artificial intelligence. The goal of ITS is to provide the benefits of one-to-one instruction. It enables learners to practice their skills by carrying out tasks within highly interactive learning environments.

Normally, computer based systems such as CAL (Computer Aided Learning) or CBT (Computer Based Training) use traditional instructional methods by providing instruction to learners without concerning themselves with a model of the learner’s knowledge. Thus, these instructions sometimes cannot assist learners individually.

By contrast an ITS assesses each learner's actions within these interactive environments and develops a model of their knowledge, skills, and expertise. Based on the learner model, it can tailor instructional strategies, in terms of both the content and style, and provides relevant explanations, hints, examples, demonstrations, and practice problems to individual learner.

In order to provide the relevant instruction to learners, an ITS system is composed of three types of knowledge, organized into four separate software modules. (as shown in Figure 1.)

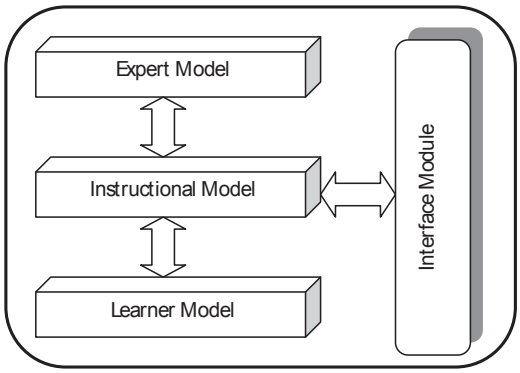

Figure 1. The components of an intelligent tutoring system

2.1.1. An Expert Model

Expert Model is a computer representation of a domain expert's subject matter knowledge (declarative knowledge) and problem-solving ability (procedural knowledge). This knowledge enables the ITS to compare the learner's actions and selections with those of an expert in order to evaluate what he or she does and does not know.

2.1.2. A Learner Model

Learner Model is a level of learner's knowledge while he/she interacts with the tutoring system. The model evaluates each learner's performance from his/her behavior during interacting with the tutoring system in order to determine his or her knowledge, perceptual abilities, and reasoning skills. The model will generate evidence and uses inference to provide a number of relevant instructions to individual learner.

2.1.3. An Instructional Model

Instructional Model contains knowledge for making decisions about instructional tactics. It relies on the diagnostic processes of the learner model for making decisions about what, when and how to present information to a leaner. For example, if a learner has been evaluated as a beginner in a particular procedure, this model will show some step-by-step demonstrations of the procedure before asking the user to perform the procedure on his or her own. When a learner gains expertise, this model might decide to present increasingly complex scenarios. Furthermore, this model may also choose topics, simulations, and examples that are relevant to a level of learner's knowledge.

2.1.4. An Interface Model

Interface Model is important as a communication medium and learning environment that can support learner in a task. It can also act as an external representation of the expert model and instructional model.

These kinds of tutoring systems can provide the learner a wide selection of practice database case studies alongside individualized feedback for solving each case study. Moreover, it is very convenient for the learners, who need to practice and learn at their own pace. The following section introduces ERM-VLE (Hall & Gordon, 1998a; Hall & Gordon, 1998b; Hall & Gordon, 1998c), COLER (Constantino-Gonzalez & Suthers, 2000; Constantino-Gonzalez, et al., 2001) and KERMIT (Suraweera & Mitrovic, 2001, 2004), three intelligent tutoring systems developed for teaching on E-learning system.

2.2 Adaptive Hypermedia

Hypermedia systems are becoming increasingly popular as tools for user-driven access to information. They typically offer users a lot of freedom to navigate through a large hyperspace. Adaptive Hypermedia (AH) combines Hypermedia with User Modeling (Brusilovsky, 1996). The content presented by the system is adapted to the user's knowledge, goals and preferences by maintaining a model of the user. In the context of educational hypermedia, the topics suggested to the learner for subsequent study would be determined by the learner's existing knowledge (Brusilovsky, 1998). AH aim at overcoming these problems by providing adaptive navigation support and adaptive

content (Kaplan C, Fenwick J, and Chen J,1993). The adaptation (or personalization) is based on a user model that represents relevant aspects of the user such as preferences (Brusilovsky, 1996), knowledge and interests. The system gathers information about the user by observing the use of the application, and in particular by observing the browsing behavior of the user.

Adaptive hypermedia build a model of the goals, preferences and knowledge of each individual user, and use this model throughout the interaction with the user, in order to adapt the hypertext to the needs of that user (Brusilovsky, 2001). For example, a learner in an adaptive educational hypermedia system will be given a presentation which is adapted specifically to his or her knowledge of the subject and a suggested set of most relevant links to proceed further (Papanikolaou, Mabbott et al, 2006). An adaptive electronic encyclopedia will personalize the content of an article to augment the user's existing knowledge and interests (Milosavljevic, M., 1997). A virtual museum will adapt the presentation of every visited object to the user's individual path through the museum (Oberlander, J., O'Donell, M., Mellish, C., and Knott, A., 1998).

A typical hyperdocument consists of a set of nodes or "pages" connected by links. Each page contains some local information and a number of links to related pages. Hypermedia systems can also include special navigation tools such as table of contents, index, and map that could be used to navigate to all accessible pages that can be adapted here are the page (content-level adaptation) and the appearance and behavior of the links (link-level adaptation). In adaptive hypermedia literature they are referred respectively as adaptive presentation and adaptive navigation support .

Adaptive Presentation is to adapt the content of a hypermedia page to the user's goals, knowledge and other information stored in the user model. There could be multiple reasons to use adaptive presentation. Two typical cases in the area of education are comparative explanations and explanation variants. The idea of comparative explanations is to connect new content to the existing knowledge of the learner.

Adaptive Navigation support is to help users to find their paths in hyperspace by adapting link presentation to the goals, knowledge, and other characteristics of an individual user. Adaptive presentation and Adaptive navigation have component to show the relationship of elements in Figure 2.

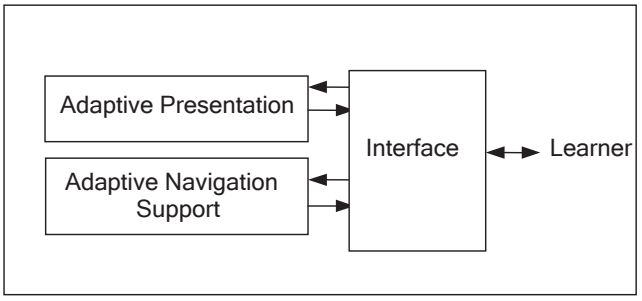

Figure 2. The components of an intelligent tutoring system

3. Adaptive Intelligent Tutoring Systems

ITS was to support a learner in the process of problem solving. It was assumed that the required knowledge is acquired outside of the system, for example, by attending a lecture or reading a textbook. Along with the growth of computer capabilities more and more ITS developers found it reasonable to provide an ITS and a learning material in electronic form in one package. Very soon it became clear that hypertext or hypermedia provides the best option for organizing on-line learning material (Hockemeyer, C., Albert, D, 1999). A combination of an ITS and AH was a natural starting point for the research on adaptive educational hypermedia into AITS.

AITS is ITS with AH into the section expert model of ITS consists Adaptive Presentation and Adaptive Navigation Support. To be a more general ITS, which means that it can be used in other domains, the ITS needs to be designed and implemented so as to support modification of the lecture content, the decision rules and the fact base of the expert model, and the methods to measure performances of learning.

The expert model shows how information about a learner and the knowledge repository are used by the expert model to identify the most appropriate content with the best teaching strategy for a given learner. The expert model

identifies what should be learned next by comparing the contents of a given course to the current knowledge of the learner .Using the prerequisite relationship between different topics, the system identifies a set of recommended lectures and depending on the learning style either presents one of them or asks the learner to select one. (as shown in Figure 3)

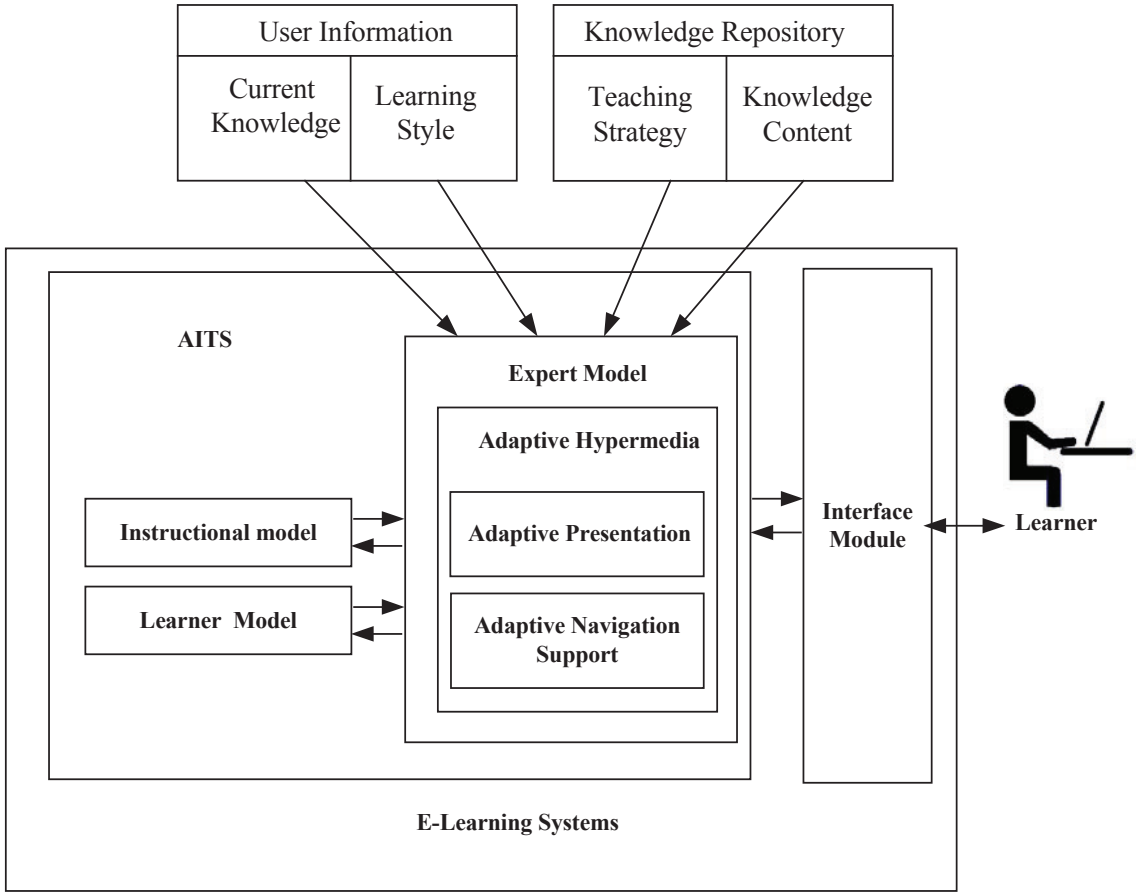

Figure 3. Conceptual of Adaptive Intelligent Tutoring Systems for E-Learning Systems

Figure 3 presents AITS for E-Learning Systems, the situation is essentially different in the case of learning produced using AH and ITS that technologies are able to dynamically select the most relevant learning material from their knowledge bases and present it at the right time and in the right way for every individual learner, thus making the best use of every fragment of educational material. Both are normally used for computer-based instruction. However, AH is better suited for the instruction of concepts whereas ITS generally assists in the use of these concepts to solve problems. Therefore, a general instruction system requires both of these instructional approaches in order to provide a full learning with adaptation based on Learners' behavior via Internet.

5. Conclusion and Future Work

Adaptive Hypermedia and Intelligent Tutoring Systems (AITS) are both effective methods of computer-based learning. At present, however, work has been dedicated to combining these systems. We propose a combined system, using for e-Learning systems to drive the connection and to personalize instruction on the basis of adaptation to learners' learning style. AITS will serve as a combined model for the two systems, allowing them to

share information on the learner's achievements. We hope that this level of coupling between concept instruction and skill practice will provide increased performance of learning.

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