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Personalized Learning Course Planner with E-learning DSS using user profile

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ABSTRACT

Various methods of e-learning systems, based on information and communications, and geared towards improving learning effectiveness and students' attention span, have been studied. However, most e-learning systems force students to follow the learning course or content established by a teacher. These methods are convenient, but they limit the effectiveness of e-learning.

To overcome this limitation and increase effective learning, new techniques that reflect alternative learning styles, such as adaptive learning and personalized learning, have been studied. In this study, we proposed a Personalized Learning Course Planner (PLCP) that allows students to easily select the learning course they desire. User profile data was collected from the students' initial priorities about learning contents as well as the test scores after their study. E-Learning Decision Support System (EL-DSS) in PLCP suggests an appropriate learning course organization, according to calculated results based on the user profile data.

To verify the effectiveness of the proposed system, we implemented an English learning system consisting of PLCP. We conducted an experiment with 30 university students and evaluated students' satisfaction by questionnaire analysis. The results indicate that the proposed system improved learning effectiveness and student satisfaction. Further investigation of the participants indicated that suggesting a learning course suitable for students' previous test scores and priorities encouraged students to concentrate on the lesson.

1. Introduction

As information technology (IT) matures, e-learning has gradually come into its own. However, it is a challenge to develop web-based learning that is suitable for the varied needs of different students. Successful learning stems from the conformity between student needs and the learning environment (Wang, Wang, Wang, & Huang, 2006). e-Learning systems that operate on the basis of internet networks currently researched are providing varied and segmented learning content to students in order to allow students to customize the organization of their personal learning course. Learning style is a new approach to e-learning systems to provide students an optimized learning environment. An adaptive learning and a personalized learning are techniques recently studied in the field of learning style.

Adaptive learning is a critical requirement for promoting the learning performance of students. Adaptive learning provides adaptive learning materials, learning strategies and/or courses according to a student's learning style (Chang, Kao, Chu, & Chiu, 2009). An advantage of e-learning is that it supports adaptive learning, which enables students to customize their learning environments and dynamically adapts learning content to students' learning needs (Huang & Yang, 2009).

Personalized learning is a public education model that tailors learning to the students' needs, interests and aptitudes. The model is dedicated to developing individualized learning programs for each student for the purpose of engaging each student in the learning process in the most productive and meaningful way to optimize each student's learning potential and success (Baylari & Montazer, 2009; Margaret, 2002).

In existing e-learning systems, a teacher organizes a learning course that consists of learning contents and sequences, according to a subject, and a student studies according to a system organized by the teacher. However, as preferences and educational levels of students are varied, and various types of content (such as text, VOD, images and sound) on a learning subject can be provided, the students must be able to choose learning content and sequences in order to study effectively. The difficulty in the existing Learning style is in selecting learning contents and sequences appropriate to the individual student, as there is no system that enables a student to organize a learning environment that is

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appropriate for him/her or that he/she desires by providing systematically analyzed materials reflecting the characteristic of the student.

In this study, we propose a Personalized Learning Course Planner (PLCP). PLCP allows students to easily select learning contents and sequences by analyzing user profile data in an E-Learning Decision Support System (EL-DSS). The user profile data was collected from the students' initial priorities for learning contents and scores after their study. EL-DSS allows students to select an appropriate learning course that is organized according to calculated results based on the user profile data. We begin with a brief review of the relevant research in Section 2, and Section 3 explains the proposed systems, PLCP and EL-DSS. A sample learning system implemented to evaluate the effectiveness of PLCP and the experiment's results are presented in Sections 4 and 5.

2. Literature review

2.1. Personalized e-learning with a user model

It is commonly believed that individuals learn in significantly different ways. These individual differences have been studied extensively under the heading of learning styles (Lau & Yuen, 2010). Thus, in an e-learning system, it is important to know and analyze how a student learns and likes to learn and how an instructor teaches to successfully address the needs of the individual students.

The ability of a personalization system to tailor content and recommend items implies that it must be able to anticipate the needs of users and provide them with recommendations of products or items that they might appreciate, based on previous or current interactions with that user, and possibly other users (Cristobal, Sebastian, Amelia, & Paul, 2009). Personalized learning is another pedagogical approach that aims to meet the needs of diverse students. While personalized learning has been defined in various terms, many of the interpretations largely converge along the lines of empowering students with more autonomy to chart their learning paths. Students are no longer the passive recipients of knowledge, as exemplified in traditional classrooms characterized by didactic teaching. Instead, they are co-producers of knowledge and have gained sovereignty over what and how they want to learn (Toh, Chen, Zhang, Norris, & Soloway, 2009).

To realize a personalized e-learning system, a user model is employed. As a user, that is, a student, interacts with the application, a user model (UM) is employed and constantly updated. The UM consists of a set of concepts with attributes that are stored in user profile files (Cristobal et al., 2009) and encodes some of the user's characteristics, such as preferences and previous knowledge (Enrique, Pilar, & Diana, 2007). The user model has some parameters, which can be determined by diagnosing the needs, interests and difficulties of the user, and the system logically adapts accordingly.

Once the user's profile has been obtained, the system can then construct a computational model to predict the student's preferences for new items in the same application domain. In fact, employing a user profile to determine student preferences can be regarded as a classification task: using known information to build a model to classify unknown events into different categories that represent different degrees of preferences (Lee, 2007). Intelligent personalized agents to model the ability of customer support assistants, which are able to learn users' preferences and needs through machine learning techniques, have also been proposed (Fabio et al., 2003). Hsu (2008) presents a personalized English learning recommendation system that incorporates two data mining techniques—clustering and the association rules algorithm. Ozpolat & Akar, 2009 propose an automatic student modeling method. In the research, the user profile is constructed using a conversion unit based on keyword mapping, and the user model is built by processing the user profile over a clustering unit and then using a decision unit. Chen and Duh (2008) present a courseware modeling process to determine the difficulty parameters of courseware and construct the content of courseware for the personalized recommendation services using fuzzy-based Item Response Theory.

An e-learning system must be able to provide an optimized learning environment by analyzing, among other things, various characteristics, educational levels and preferences of students. In the proposed system of this paper, PLCP plays this role in the e-learning system. The student's initial data are accumulated and recalculated with learning data added while the student performs his/her learning. During the next learning period, the system suggests learning content and sequences to the student on the basis of analyzed data in PLCP. A detailed structure of PLCP is explained in Section 3.2.

2.2. DSS for e-learning

A Decision Support System (DSS) is an interactive, computer-based system intended to provide support to decision-makers engaged in solving various problems involving multiple attributes, objectives and goals (Lin, Lin, Lin, & Yang, 2009). DSSs are designed and implemented to support organizational as well as individual decision-making. Without a detailed understanding of decision-making behavior in organizations, decision support is close to meaningless as a concept. Organizational scientists classify organizational decision-making in terms of several schools of thought: (1) the rational model, which focuses on the selection of the most efficient alternatives with the assumption of a rational, completely informed single decision-maker; (2) the organizational process model, which stresses the compartmentalization of the various units in any organization; (3) the satisfying model, which reflects 'bounded rationality' to find an acceptable solution; and (4) other models (Eom, 2001). To make a decision or choose a best alternative, a decision-maker (DM) is often asked to provide his/her preferences either on alternatives and/or on the relative weights of attributes (Wang & Parkan, 2006). Chen and Wang (2009) present a generalized model for prioritized, multi-criteria decision-making systems. In the research, they construct a method in which the weights of the lower priority criteria of each alternative depend on whether or not each alternative satisfies the requirements of all the higher priority criteria.

The following examples apply DSS to e-learning. Sacks, Mendes, Martinez, and Sacks (2002) propose Knowledge-Based Content Navigation in e-Learning Applications. This method employs fuzzy clustering to identify relationships between learning materials and to dynamically organize them into knowledge domains. Ganesh and Jigish (2002) examine the learning strategies employed by DSSs and organizations and discuss different kinds of DSSs that can facilitate, promote, and enhance organizational learning.

DSS for e-learning is useful in providing guidance to managers, as managers at different companies are interested in the concept of organizational learning and are looking for new ways to enhance and promote learning in their organizations. Hartley and Almuhaidib (2007) present an educational decision support system that links to a middle-tier decision-making support system with a query generator. In their research, they explore the data distributions to meet the requirement of decision-makers who analyze the decision situation and task according to their personal preferences, values and knowledge.

In this paper, EL-DSS in PLCP analyzes user profile data and, on the basis of the analyzed results, allows the student to select an optimized learning environment. Section 3.5 represents EL-DSS in detail.