

Web Service based Personalized learning System using User's Preferences: AEHS Approaches

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Abstract: AEHS (adaptive education hypermedia system) analyzes users' learning patterns and their learning process and according to the analyzed learning performance, the system identifies the most appropriate process for each user. However, in AEHS, it is difficult for users to choose learning contents fitted for their preference or learning ability. It has still lack that user can select a learning content. Also, recently, web service technology is hot issue of all areas, computer science, network, application, and platform via the internet. This technology can be applied in e-learning system to improve learning effect. In this research, we propose a web service based personalized learning system in order to provide learning contents with user's preference and process the learning service efficiently. This system enables users to choose a content delivery and a difficulty level of the learning contents according to their preference. The content delivery can be video, picture, text, and sound, and difficulty level has very high, high, normal, easy, and very easy. Especially, difficulty level that is to fitting abilities of learners is generally applied to item for the question. The idea of this paper is also that learning content as well as item have difficulty level. Advantage of this idea is that learner can study with learning contents fitted for their learning ability. To provide this method, we added the module, learning contents preference and learning difficulty preference, to user profile of AEHS. According to the method, we implemented e-learning system to study English. The results of experimental study with university students in South Korea showed that the proposed system with a preference and ability is effective on the learning improvement.

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1. Introduction

Generally learning system uses the LMS (learning management systems) for management learning materials include learning contents and items. Teachers use an LMS to develop Web-based learning course notes and quizzes, to communicate with learners, and to monitor and grade learning progress. Learners use it for studying, communication, and collaboration. Regardless of user's knowledge, goals, and interests, all users taking an LMS-based course receive access to the same educational material and the same set of tools, buffered with no personalized support [1].

In order to provide user oriented learning, adaptive learning systems were proposed. That is, adaptive web systems allow users to navigate from one item to another and search for relevant items [2]. Adaptive learning is the use of technology to assist learners in the absorption of learning materials [3]. Researchers have developed various computer-assisted learning or web-based learning systems to provide a more adaptive learning environment with plenty of learning resources [4]. As the method to make good use of adaptive learning environment, AEHS (Adaptive Educational Hypermedia System) was proposed. AEHS tailors what the learner sees to that learner's goals, abilities, needs, interests, and knowledge of the subject, by providing hyperlinks that are most relevant to the

user. AEHS is an approach which target is to personalize the learning experience for the learner [5]-[9]. Many learning systems including AEHS provide learning course made according to learning contents and items subdivided by difficulty levels for learners. Also, learning contents are made of content delivery (i.e., Video, Picture, Text, and Sound) and provided along the learning course through a hyperlink. These systems lack flexibility that learners study with the learning contents fitted for their learning ability or preference.

To overcome this limit, proposed learning system was modified modules in user profile of AEHS so that learners can choose a delivery and a difficulty level of learning content in order to provide personalized learning process to user. And, recently, IT development's environment has been changed from a user's own software to a service. Web

services provide technology-independent interfaces and standards allowing for the encapsulation and componentization of software and applications [10]. Therefore we developed web service based learning system with LMS. For personalized learning, we used two types of difficulty level, learning contents difficulty and item difficulty. Learning contents difficulty that is proposed method in this research refers to the relative difficulty of learning material. And item difficulty that

is exist method is a measure of the percentage of users answering a question correctly [11]. Difficulty preference data includes both of them. A user profile use to manage learners' data and supports the teacher to find their learning preference about the courses. A content delivery and difficulty preference are stored in learner information and historical information of user profile data. With using this system, the users can keep their concentration on the study and improve their learning performance.

2. Literature Review

2.1 AEHS with Personalization

AEHSs are able to adapt various visible aspects of the hypermedia systems to the individual requirements of the users and are promising tools in the area of e-learning. Especially in the area of e-learning, it is important to take the different needs of learners into account in order to personalize learning goals and paths, help them get used to interacting with the e-learning systems, and support them during their learning progress [12]. Personalization aims to provide learners with what they need without requiring them to ask for it explicitly [13]. For the personalization, user profiling is a promising approach towards the personalized e-learning systems where user profile data (i.e., interests, levels, and learning patterns) can be assessed during the learning process [14]. Previous studies explain that 'explicit user profiling' requests each learner to declare personal information, such as age, gender, and occupation, or to fill out questionnaires that explicitly state their preferences, while 'implicit user profiling' tracks the user's behaviour and is generally transparent to the learner [15]-[16]. In fact, personalization features can augment learners' involvement and reduce their workload [17]. However, most previous studies about the personalization using user profile were adapted to a learning process and a questionnaire. For more personalization, we modified and adapted the user profile to AEHS; thereby, it enables a learner to choose the content delivery and difficulty of learning content which s/he prefers.

2.2 Web service with E-learning System

Web Services technology is a platform on which we can develop applications taking advantage of the Internet infrastructure. A Web Service, specifically, describes particular business functionalities that a company wants to expose through the Internet with the purpose of providing to other companies a way for using them. The key is on-the-fly software creation through the use of loosely coupled, reusable software components. Web Services promises to facilitate automated application level business integration using the ease of connectivity to and global presence of the Internet infrastructure and replacing proprietary

interfaces and data formats with a standard web-messaging infrastructure exploiting XML technology [18].

3. Web Service based Personalized learning System with User Profile

We propose the learning system model with web service, as shown in Fig 1. This model consists of three databases; learning style database, web service database, and learning course database. And the model also has two processes; interface agent and learning course process. In this architecture, we make a learning process in order to provide learning contents to learners efficiently.

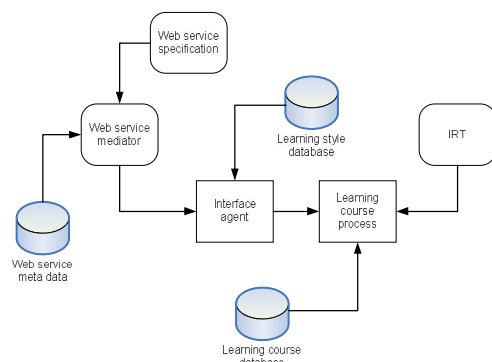


Fig.1. Proposed web service based e-learning system structure

On the basis of this structure, we added the module to user profile for supporting learners' preferences and developed an e-learning system. Figure 2 shows the proposed personalized learning system's architecture of AEHS using user profile with LMS and LCMS. The User profile consists of existing elements that are learner information (such as age, gender, and occupation, etc) and history information of study, and Learning contents preference and Learning difficulty preference newly added to support the preference of learning content and difficulty. LCMS provides learning content for Learning contents preference that supports the content delivery of the contents preferred by learners. Learning difficulty preference enables for learners to choose the difficulty level of learning contents. It is provided the item difficulty and the learning information from the learning information repository of LMS.

Figure 3 shows the logic process in web service of proposed learning system with user profile. Through the learning process in LMS, learners can be supported after setting up their learning levels and target scores, considering the learning section, their set-up learning plans, content delivery, and the difficulty levels of learning content and item. The system analyzes and evaluates their learning performance and provides these

results to them. The ‘Learning level’ means the level of learning content difficulty (e.g., High, Middle, and Low) and its construct designed ahead by a teacher. The questions are adapted based on the item difficulty.

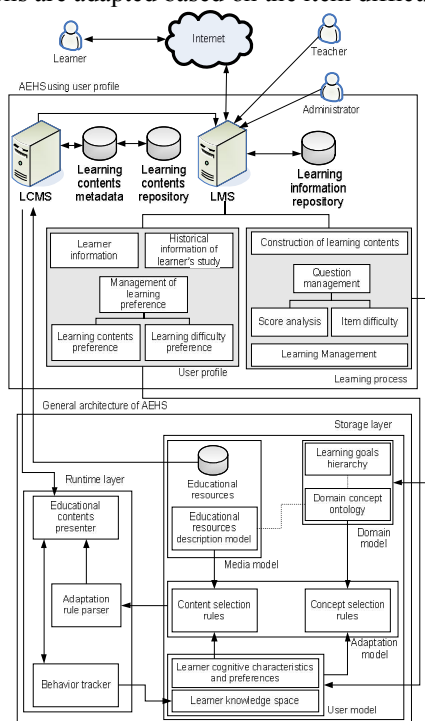


Fig. 2. The architecture of proposed personalized learning system with user profile and learning process

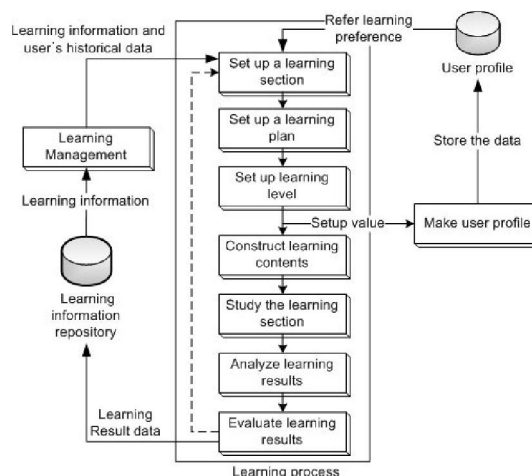


Fig. 3. Proposed learning logic process in web service

Figure 4 shows the process of the learning course. Considering the difficulty of learning content and item, a learner sets up the learning level before starting the course. Also, teachers set up each level of difficulty on learning contents and items according to learning materials while they develop learning contents. A learner can choose a difficulty level of learning contents and that of items before taking a course, and also can choose the learning styles that s/he prefers. This process becomes ‘Set up learning information’ stage and it corresponds to ‘Set up a learning section’, ‘Set up learning plan’, and ‘Set up learning level’ as previously shown ‘Learning process’ in Figure 3.

Table 1. Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest: Quiz	53.98	128	8.450	.747
	Post-test: Average of 10 Quizzes	64.0834	128	6.86504	.60679
Pair 2	Test score before learning	502.2969	128	103.83773	9.17805
	Test score after learning	567.3672	128	109.33816	9.66422

Table 2. Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pre-test (quiz) & Post-test (average of 10 quizzes)	128	.915	.000*
Pair 2	Test score before learning & Test score after learning	128	.956	.000*

Table 3. Paired Samples Test

		Paired Differences				
		Mean	Std. Deviation	Std. Error Mean	Df	Sig. (2-tailed)
Pair 1	Pre-test (quiz) & Post-test (average of 10 quizzes)	-10.09906	3.50976	.31022	127	.000*
Pair 2	Test score before learning & Test score after learning	-65.07031	32.18455	2.84474	127	.000*

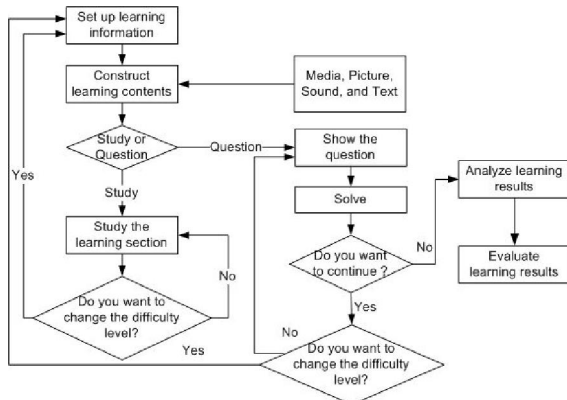


Fig. 4. The screen of proposed learning system's content with Video and Text

Figure 5 shows the proposed system and its screen of the course selected by the learner. At this stage, the learner chooses course items before taking the course. The selected course items (e.g., difficulty of learning contents) are used as 'Setting values' to update the learner's 'User profile'. The section of 'The previous information of yours' represents previous learning information of the learner. The 'Course' shows chapters that the learner studied before.

4. Experiments

To verify our expectation that, by using this system, the learners can keep their concentration on the study and improve their learning performance, we carried out an experimental study. By analyzing the learning performance of experimental group using the proposed system, we measured the effectiveness of the system. Participants for this study were 128 students, freshman and sophomore, of online university in South Korea that offers distance learning degree programs for adult learners. To test the effectiveness of proposed system, 128 students participated in the process of this learning system for 6 months. The quiz scores using the system and their scores are measured before and after taking the learning program developed in this study. The quiz used for pre-test and post-test was pre-designed with similar difficulty level. We used the paired-samples T-test procedure which is used to test the hypothesis of no difference.

Each student's ten quiz scores were averaged to obtain her/his average pre and post-test quiz score. The results showed that this system had a positive effect on the learning performance. Across all 128 subjects, pre-test quiz scores improved about 10 points on average after 6 months of the new learning. The subjects' English test scores after using the proposed learning system also clearly increased average score about 65 points (See Table 1). At .915 and at .956, the correlations between the pre and post-tests were statistically significant (See Table 2). This result indicates that all subjects' quiz and exam scores

improved and did so quite consistently. In Table 3, the Mean column displays the average score difference before and after taking the learning course developed in this study. Since the significance value for change in the quiz score is less than 0.05, we can conclude that the average increase of 10 points per student is not due to chance variation, and can be attributed to the proposed learning system developed in this study. The significance value less than 0.05 for change in the test score also shows that the proposed learning system significantly improved the students' test scores.

Figure 6 shows the learning content of proposed system constituted by video and text.



Fig. 5. A screen for selecting the preference in the proposed system

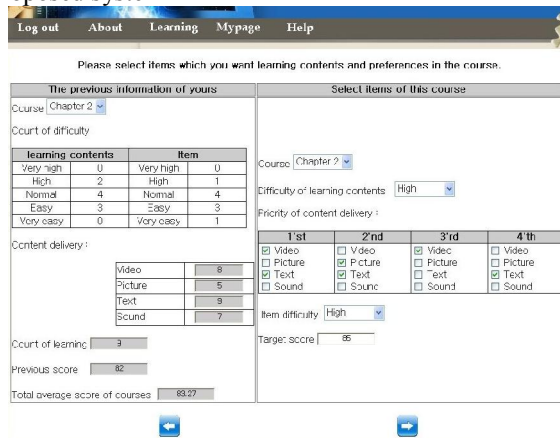


Fig. 6. The screen of proposed learning system's content with Video and Text

5. Conclusion

In this paper, we proposed an advanced web service based learning system for AEHS that enables learners to choose a content delivery of learning content and a difficulty level of the learning contents according to their preference and ability. The user profile was adapted to the learning preference divided into three parts: the content delivery, learning contents difficulty, and items difficulty for question. In the system, the

learning preference can be changed by learner. The system provided also flexibility that is to change depending on the preference of the learner at anytime during the course. We expected that by keeping their concentration on the study, the learner can improve their learning performance. To verify our expectation, we carried out an experimental study and from the analyzed the quiz and English learning course's test results of experimental student group using the proposed system we can verify the effectiveness of the system. In the experiment to verify the effectiveness of the proposed system, because we did not compose control group, there can be room for doubt about the test score increase. The experimental group was composed the students of online university, and they were adult learner. Therefore they were in different environment such as location, concentration and keep in touch with the system. For this reason, we used the measurement that tested the quiz and English learning course to compare the score to the sample group. About 65 point increase of English learning course's test score comes from not only the effectiveness of the system but also the learning period itself.

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